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A Novel Hybrid Music Recommendation System using K-Means Clustering and PLSA

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Abstract

We propose a hybrid approach of music recommendation according to which user will get recommendations of the songs searched by the other users alike to the existing user on content basis and also songs listened by that similar set users on context basis. Here we will try to find the similar users on the basis of context using K-Means clustering technique and among those users we will find the most frequent or most listened songs on the basis of content using PLSA technique. To fulfil this task we have created a dummy dataset and taking assumption that it is valid for experimental point of view. In order to evaluate the utility of recommendations produced by using proposed approach of music recommender system, we have computed three metrics i.e. Precision, Recall and F-1 Score. The result of proposed methodology shows the promising result as evaluated by parameters i.e. precision, recall and F1-score on dummy dataset. It can be tested for the real dataset of users from future perspective which will definitely going to take some time because of availability of such data.

Keywords: Content Based, Context Based, Hybrid Music Recommendations, K-Means, PLSA

1. Introduction

In today's era, music is considered to be significant aspect of their lives. Music will become an activity for the people in which they are engaged frequently. Music recommender system has become a popular area for research. Poor hardware expenses and improvements in technology lead hasty expansion in digital music. The huge music quantity offered nowadays makes very complex task for customers to discover the suitable music hence it can be significant to sort out the music which are appropriate to every customer. Moreover, music recommender systems easily filter the songs and find them according to the user's taste.

In[1] proposed a music recommender system having three elements i.e. user modeling, item profiling and match algorithms. In this work, six recommender models have been discussed. This briefly studies the two widely used techniques: Content based and collaborative filtering techniques respectively. And it can be found that collaborative approach has performed well. In this work, a motivation based model has been proposed which utilizes the empirical studies of human behavior, music psychology etc. Furthermore, emotion based model which is one of the user centric scheme has been discussed and studied in this paper.

In[2] proposed novel technique to suggest suitable tracks from a collection of songs to the user. The main aim of the recommendation system is to suggest music which are mostly listened by the user, are new for the listener's ear and fit the user's listening pattern. This paper employs an application to calculate presented scheme in the real world. The user logs of trial volunteers show good performance of the proposed method.

In[3] presented an approach for detecting social tags from MP3 file. Audio features can be mapped on to the social tags aggregated from web by using a group of boosted classifiers. The auto tag which is generally an automatic tag provides the information related to music. This helps to avoid the cold start issue. This cold start issue is usually very common in the recommendation system. Auto tags may further smooths the tag space which helps to make similarities and suggestions by giving group of equivalent baseline tags for the entire tracks in system.

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In[4] proposed Context-based Music Recommendation (COMUS) ontology. This proposed approach has been used for modeling user's musical favourite choice. This approach gives an upper Music Ontology which confines ideas regarding the common song attributes like title, artists and genre and moreover gives extensions for accumulating domain-specific ontologies, such as music mood, feature and condition, in a hierarchical manner. The proposed approach may be used the logical reasoning rules by inspecting the reliability of framework information. This ontology scheme helps to explain complex relations among music and situation, allowing subscriber to investigate suitable music for the application.

In[5] presented a music recommendation system in this paper that is depending on the analysis of user preference. In this work, recommendation system establishes a new model which utilizes hidden Markov model. Every song has been modeled by hidden Markov model and also the similarity measures among songs are defined that rely on the models. By the help of similarity measure, songs which are listened by the user in the past are combined and analyzed. On the basis of the result analysis, the system suggests music to the user. This proposed system is estimated with the virtual users who have several choices and examine which suggestion lists is generated by the system.

In[6] proposed a hybrid recommendation system in this paper and this system is based on incrementally trainable probabilistic model. This hybrid recommender system is the combination of collaborative and content-based approaches. This proposed system overcomes the problems among suggestion accurateness and range of suggested artist. CF approach may be utilizes E-commerce sites, cannot suggest non brated pieces and gives a narrow variety of artists. On the other hand, content based approach will not provide accuracy as dependence on heuristic that means user's preferred pieces have same melodic content. In order to get the higher accuracy and precision, probabilistic generative model has been used which combines the collaborative and content-based data. The result indicates that the proposed system gives high amount of accurateness yet the addition of new consumers.

In[7] proposed a *personalized hybrid music recommendation method that aggregate three approaches:* Content-based, collaboration-based and emotion-based methods. In order to calculate the accuracy of recommendation system, a novel system has been build which can suggest the music to the user. The presented approach can contain the variation in the user's music interest with the help of feedback of the user's options. The results indicate that the proposed method achieves accuracy around 90%, thus it is helpful to user.

In[8] paper presents new dynamic music resemblance measurement policy that makes use of together content features and consumer access patterns. The flawless incorporation of them radically improves the music resemblance measurement accurateness as well as performance. On the support of this policy, suggested songs are acquired as a result label broadcast over a graph depicting music resemblance.

In[9] proposed a system for music recommendation that gives personalized services. In this system, music is mapped into a point in the property space and the time is transformed into the weight of the point. As further newly the consumer listens to the music, the increase the weight enhances. In this work, K-Means cluster process is applied to the weighted points. This algorithm is improved so that the amount of clusters is altered with dynamism. This experiment is performed with one hundred pieces of music.

In[10] anticipated a scheme of music recommendation that gives a modified usage of music suggestion. Initially, polyphonic music items of MIDI format are examined for getting data. The representative track of every polyphonic music item is analyzed firstly and after that six features are extracted from the same track for appropriate music grouping. The various approaches such as collaborative, hybrid and content based are presented depending on the favourite degrees of the users to the music groups.

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2. Proposed Methodology

In our previous work[12] we proposed a hybrid K-Means PLSA technique for music recommender. According to this approach, user will get recommendations of the songs searched by the other users alike to the existing user on content basis and also songs listened by that similar set of users on context basis. Here we will try to find the similar users on the basis of context using K-Means clustering technique and among those users we will find the most frequent or most listened songs on the basis of content using PLSA technique. The songs listened by the users

will be categorized proportionally after which the most set of songs listened by other users will be recommended to the current user. We have already explained the concept of K-Means procedure and Probabilistic Latent Search Algorithm in our previous work. Here in this research paper we have provided the evaluation results of our proposed technique. The flow chart of the proposed methodology is given in Figure 1.

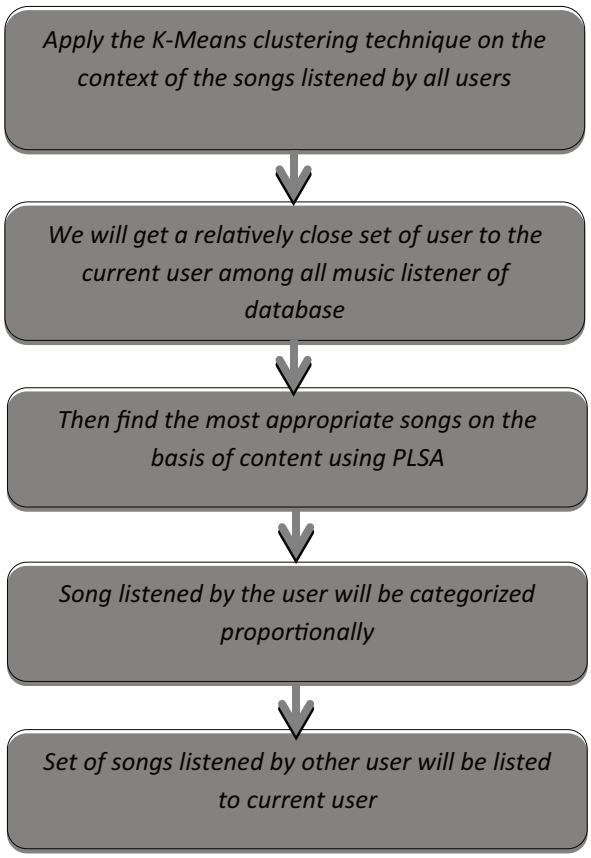

Figure 1. Flow chart of proposed methodology[12].

To perform the evaluation of the proposed work, the whole music recommender system has been implemented using web architecture. The language used for implementing the scripting of web page is PHP. In order to evaluate the utility of recommendations produced by a recommender system, the three metrics are used that are Precision, Recall and F-1 Score. The F-1 Score is distinct from the other ones, since it is a measure of a test's accuracy and considers both the precision and the recall of the test to calculate the final score.

Precision: Precision of a recommender system is the part of the correctly suggested stuff among the total suggested stuff.

$$precision = \frac{correctly\ suggested\ stuff}{Total\ suggested\ stuff}$$

Equation 1

Recall: Recall of the recommender system is the part of correctly suggested stuff among the relevant stuff.

$$recall = \frac{correctly\ suggested\ stuff}{Relevant\ stuff}$$

Equation 2

F1-Score: The F1-Score attempts to combine precision and recall interested in a particular score by computing diverse types of means of both metrics. The F1-Score is considered as the standard harmonic mean of precision and recall:

$$F1 = \frac{2 \times precision \times recall}{precision + recall}$$

Equation 3

The experimental values of above parameters are calculated in Table 1 and Table 2 for proposed work and base respectively. The whole test is performed on dummy dataset of 100 users generated randomly using both proposed as well as base[11]. It is also assumed that the dataset generated is valid. Figure 3 shows the precision between proposed and base[11] against different users taken at random which is coming out to be above 0.6 for proposed and can be considered as good score in terms of precision. Figure 4 shows the recall between proposed and base[11] against the same set (taken in precision) of different users the minimum value of recall is found to be 0.4 in case of proposed which is considered as good values for recall. Figure 5 shows the comparison of F1-Score between proposed and base[11] which is been calculated using precision and recall. Figure 2 depicts the conceptual view of the proposed idea:

3. Conclusion and Future Scope

Music recommender system using hybrid approach of K-Means and PLSA for recommending music is expected to be efficient for its users. Such system saves the time of users in searching and along with that fulfilling their need in terms of searching without even making effort by the users. We have extracted the relative users or similar users depending on their interest among different set of users. To fulfil this task we have created a dummy dataset and taking assumption that it is valid for experimental point of view. After having a group of user, we have extracted

Table 1. Experimental values of precision, recall and F1-Score of base paper

Users	3	11	25	39	51	65	78	89	99
precision	0.75	0.5555	1	0.5	0.6	0.444	0.5555	0.7777	0.5
Recall	0.35	0.29411	0.52941	0.29411	0.35294	0.23529	0.29411	0.41176	0.23529
f1-score	0.48	0.38461	0.69230	0.37037	0.44444	0.30769	0.38461	0.53846	0.32

Table 2. Experimental values of precision, recall and F1-Score of proposed

Users	3	11	25	39	51	65	78	89	99
Precision	1	0.8888	1	0.7	0.9	0.7777	0.7777	0.7777	1
Recall	0.4705	0.4705	0.5294	0.4117	0.5294	0.4117	0.4117	0.4117	0.4705
F1-Score	0.64	0.6153	0.6923	0.5185	0.6666	0.5384	0.5384	0.5384	0.64

the items which is to be recommended to user among the selected group using PLSA on the song listened by the users. To perform experiment on proposed algorithm whole system is setup using web application. The result of proposed methodology shows the promising result as evaluated by parameters i.e. precision, recall and F1-score on dummy dataset. It can be tested for the real dataset of users from future perspective which will definitely going to take some time because of availability of such data. We need to extract it after ample use of web application and then have to apply the same for getting result.

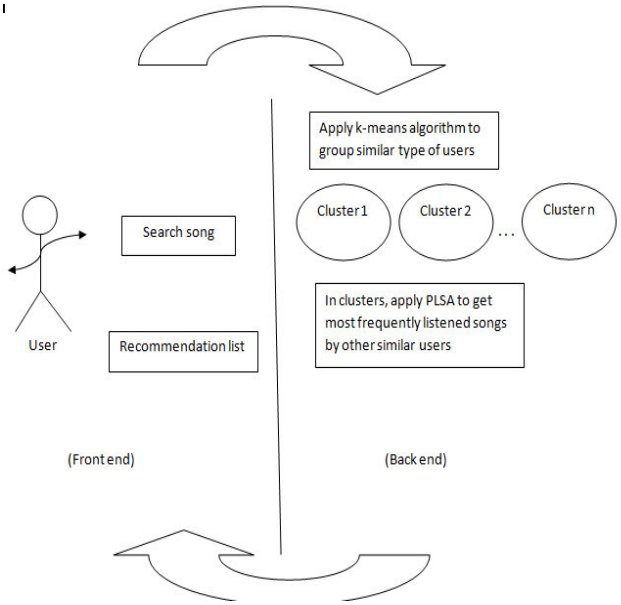

Figure 2. Conceptual overview of the proposed work.

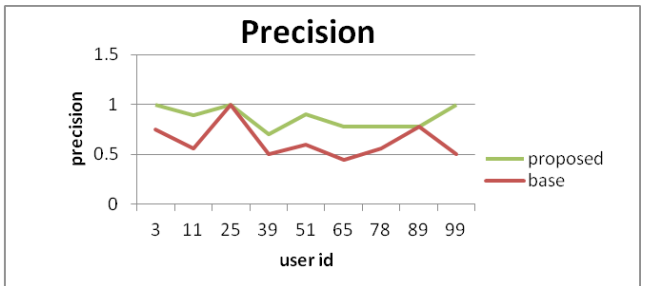

Figure 3. Precision versus different users.

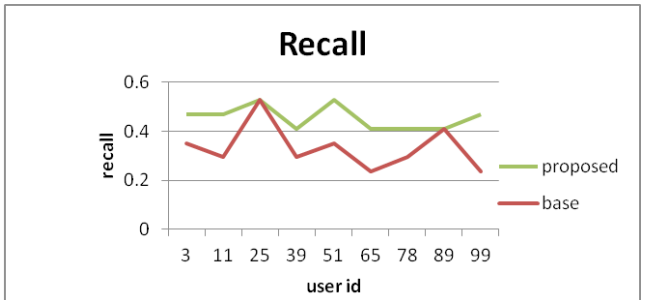

Figure 4. Recall versus different users.

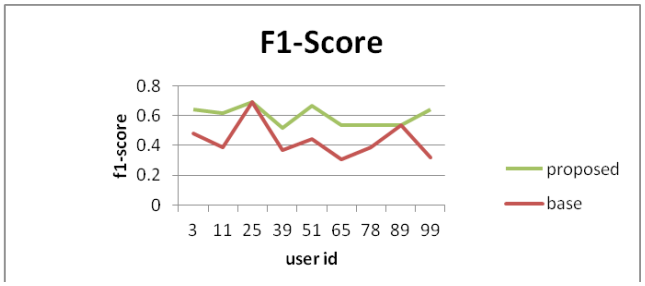

Figure 5. F1-Score versus different users.

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