International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 05 | May - 2022 Impact Factor: 7.185 ISSN: 2582-3930

Music Recommendation System using Content and Collaborative Filtering Methods

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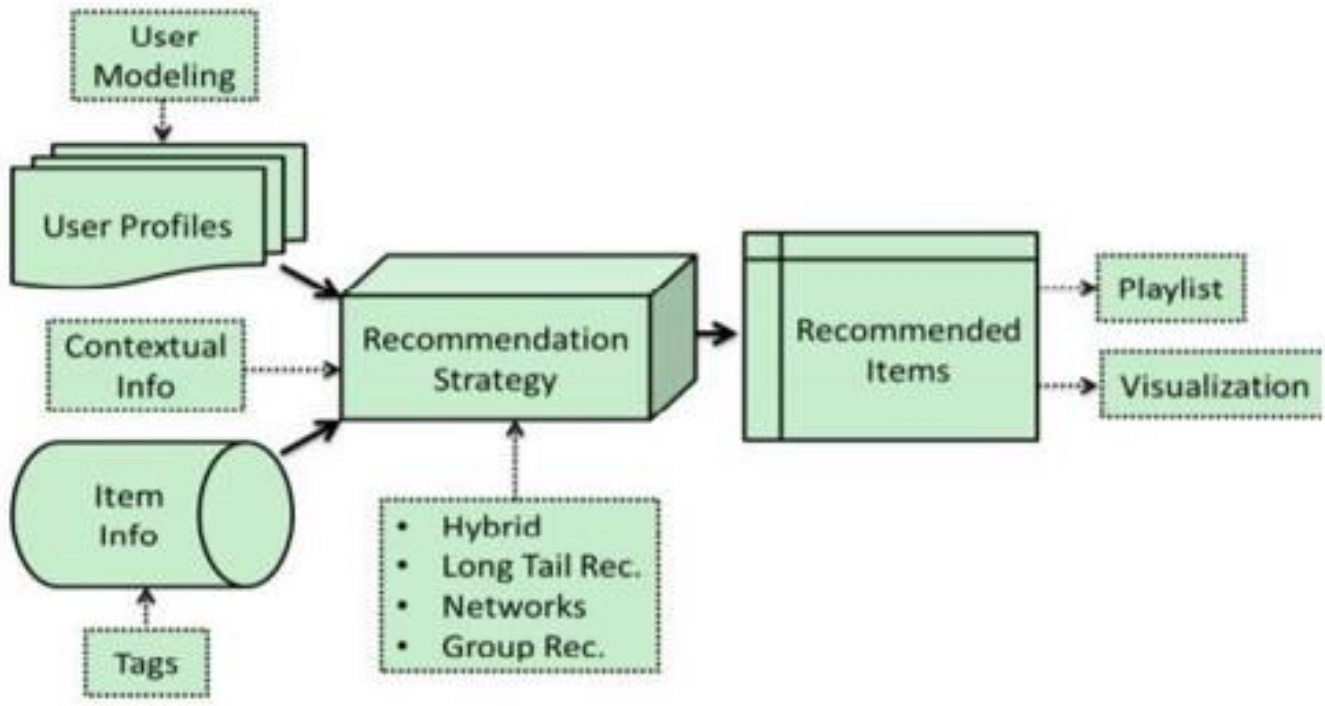
Abstract- Rapid development of mobile devices and internet has made possible for us to access different music resources freely. While the Music industry may favor certain forms of music over others, it's important to grasp that there isn't one human culture on earth that has existed without music. during this paper, we've designed, implemented and analyzed a song recommendation system. we've used Song Dataset provided to search out correlations between users and songs and to find out from the previous listening history of users to supply recommendations for songs which users would like to concentrate most. The dataset contains over ten thousand songs and listeners are recommended the simplest available songs supported the mood, genre, artist and top charts of that year. With an interactive UI we show the listener the highest songs that were played the foremost and top charts of the year. Listener even have the choice to pick out his/her favorite artist and genres on which songs are recommended to them using the dataset.

Keywords- Collaborative model, Content based model, Recommendation System, Popularity model

I.INTRODUCTION

Everyone's taste in music is exclusive which implies that irrespective of what music you create, someone is absolute to enjoy taking note of it. While the Music industry may favor certain styles of music over others, it's important to grasp that there isn't one human culture on earth that has existed without music. Music is of great benefit to us, irrespective of whether we are renowned recording artists, karaoke singers or merely fans of music. the quantity of songs available exceeds the listening capacity of single individual. in step with the MarsBands.com there are a minimum of 97 million songs. These are only the songs officially released. If we included songs everyone knows or the incredibly old Celtic songs with no names, we'd reach 200 million songs since the web site presumably doesn't include Happy Birthday or a nameless song from 1400 AC. this is often after we take only the artists who had their name officially on Music charts. Starting there, for instance that there are currently around 1 million songwriters alive that we all know about. If we use the identical percentage as above, we are able to guess that there are about 15.3 million songwriters ever. to induce an inspiration, there are 4 million songs on Spotify that haven't been played. In total, there must be billions just there and Spotify itself is by no means the limit of music. What about all the CDs and records revamped the past century which haven't been digitized? What, indeed, about song passed down the generations in small African communities? There are trillions and trillions of songs within the world, such a lot of that an estimate is impossible, and also the potential more an infinitely greater number which haven't yet been made, a world of music for us to enjoy. Keeping this general idea, one can get that the quantity of songs are too high for someone, whether or not paying attention to music is his or her best hobby. People sometimes feel difficult to decide on from variant songs. Moreover, music service providers need an efficient thanks to manage songs and help their customers to get music by giving quality recommendation. this implies it not only gives user freedom of choosing the songs he or she wants to concentrate but also recommends songs in line with their previous listening history. Thus, there's a powerful need of an honest recommendation system. so as to efficiently access, discover, and present music content to the ultimate user, techniques for searching, retrieving, and recommending must be appropriate for music content. There has been some work worn out both academia and also the industry to supply music recommendation services. Understanding patterns of music listening and consumption can help to perform accurate and satisfying music recommendations. This paper aims to present the event of music recommendation and discovery methods up to now, and identify the problems in evaluation that also require careful consideration and research. Music recommender system may be a system which learns from the users past listening history and recommends them songs which they might probably prefer to hear in future. Currently, there are many music streaming services like Pandora, Spotify, etc. which are performing on building high-precision commercial music recommendation systems. These companies generate revenue by helping their customers discover relevant music and charging them for the standard of their recommendation service. Thus, there's a powerful thriving marketplace for good music recommendation systems. In this proposed system, the motive is to create an efficient recommendation system for music and add a friendly computer programme for the benefit for the listeners. The goal of a music recommendation system is to assist consumers and also the music industry with the invention and delivery of music. so as to comprehend the personalized distribution of music, it's going to be beneficial for recommender designers to grasp the music listening behaviors and fathom the state of music consumption within the industry. Understanding user preference and behavior can help to propose an affordable recommendation to a selected user. as an example, some users show a transparent bias towards style when choosing music, while some emphasize timbral similarity. so as to

create recommendations respectively to those two styles of listeners, the recommender must specialise in different attributes. Moreover, users' feelings and expressions will be different towards the identical music, such that a customized user profile is required for every user before the system can make meaningful recommendations. Generally, a user's preference shifts with time, in terms of years, seasons, days, and even hours. as an example, a user who liked calm and soft music before, may like noisy music now. So, a user's profile needs update and maintenance to explain the music preference of the user at a time. Unlike the consumption of movie, books, and games, people hear music repeatedly and continuously. This adds more complexity to capture a user's preference accurately, which is vital for a music recommendation system. The diagram of a music recommendation system is as shown in fig. 1



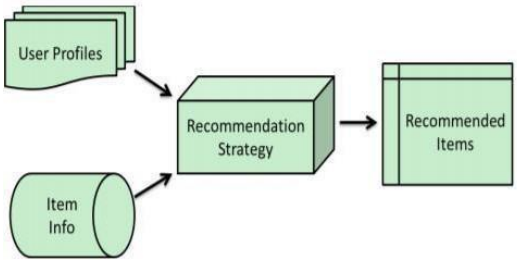


Fig. 1. An illustration of Music Recommendation System

The rest of the paper is organized as follows. In section 2, we explain related work. Section 3 highlights the proposed system. Section 4 discusses the music recommendation application. Section 5 does the result analysis and section 6 concludes the paper.

II RELATED WORK

Bertin Mahieux T et al. [1] proposed 1,000,000 Song Dataset Challenge: an oversized scale, personalized music recommendation challenge, where the goal is to predict the songs that a user will hear, given both the user's listening history and full information (including metadata and content analysis) for all songs. They describes the three algorithms wont to produce baseline results: a world popularity based recommender with no personalization, a straightforward recommender which predicts songs by artists already present within the user's taste profile, and eventually a latent factor model. All results are supported a train-test split that's similar, but may differ from the split to be utilized in the competition. The training set consists of the total taste profiles for roughly 1Million users, and partial taste profiles for the 10K test users. An effective cross-platform music player, EMP, which recommends music supported the real-time mood of the user is proposed by Shlok Gilda et al. [2]. EMP provides smart mood-based music recommendation by incorporating the capabilities of emotion context reasoning within the adaptive music recommendation system. Music player contains three modules: Emotion Module, Music Classification Module and Recommendation Module. The Emotion Module takes a picture of the user's face as an input and makes use of deep learning algorithms to spot their mood with an accuracy of 90.23%. The Music Classification Module makes use of audio features to realize an interesting results of 97.69% while classifying songs into 4 different mood classes. the advice Module suggests songs to the user by mapping their emotions to the mood kind of the song, taking into consideration the preferences of the user. In their paper, Miao Jiang et al. [3] propose an improved algorithm supported deep neural network on similarity between different songs. The proposed method makes it possible to create recommendations in a very large system to form comparisons by "understanding" the content of songs. This paper proposes a model supported recurrent neural network to predict user's next most possible song by similarity. They conducted experiments and evaluations supported Million Song Dataset and demonstrate how it outperforms the normal methods. It collected the lyrics for a complete of 34412 songs, and audio samples for 4240 songs, leading to a lyrics dataset consisting of 28,000 pairs, and an audio dataset consisting of 1000 pairs. Cross validations was conducted for both to separate the datasets into training and testing sets. The proposed model within the paper is predicated on a Long-short term memory-based architecture. The motivation behind using an LSTM-based architecture stems from the very fact that audio is inherently sequential in nature and therefore the similarity between two songs (particularly between their audio signals) must in a minimum of a way be determined by the similarities between their sequences over time.

Parmar Darsna [4] proposed a song recommendation system for user to urge particular item of his/her interest supported 2 popular algorithms, Content Based Filtering and Collaborative Based Filtering. Content-Based method recommends music supported user data. Content based method music subjective features are Speechiness, Loudness and Acousticness etc. These features are stored in database using k- mean clustering algorithm. Collaborative Based method recommends on the user rating and content sharing between different users. during this method, rating given by user to particular music is taken into account and find cosine similarity between users. Cold-Start is solved by recommending most well liked tracks to new user. The dataset is downloaded from MovieLens Website. It contains 100004 rating and 1296 tag application across 9125 movies. during this model, Spotify API is employed to urge the songs. In this, any of artist name, if information is accessible on Spotify should run then it'll fetch the info associated with it.

Dmitry Bogdanov et al. [5] discussed a recommendation system within which the workflow of the implementation of the system are often divided into data gathering, audio analysis, music recommendation, and preference visualization. The user specifies his/her account name on Last.fm and/or SoundCloud services from which the popular tracks should be retrieved. Canoris 8 API has been accustomed obtain semantic descriptions. Canoris may be a web service developed by the UPF's Music Technology Group 9 for the analysis and synthesis of sound and music. to come up with recommendations, an in-house music collection of fifty,000 music excerpts, covering a good range of musical genres was used. This collection was analyzed via the Canoris API to retrieve the identical semantic descriptions as used for the preference set. Using this, a group of songs near the user's preference set is made and presented to the user.

Ms. Nishigandha Karbhari et al. [6] presents a model to placement recommendations System supported marks of student. It uses 3 approaches; collaborative recommendation approach, content recommendation approach and hybrid recommendation approach. They present a way to think about the various needs with varying level of competence.

Categorizing students supported their credentials thereafter, it discovers best solutions to get recommendations for placement supported the marks and various other factors included within the profile of the coed. Using these soft computing techniques, the coed may be mentioned the task profile which isn't used as reference for the location otherwise.

Markus Schedl [7] focused on the group of classic music listeners and investigated a large range of advice approaches and variants for the task of music artist recommendation. Analyzation is finished in stand-alone and hybrid recommendation approaches. Each user u incorporates a listening profile L u, which contains all items (artists) listened to. The standalone models are popularity based, collaborative filtering, content based and random based while hybrid model may be a fusion of 1 or more Single model. The listeners are divided into groups supported their age, country and time of the day they like taking note of music. the complete dataset covers almost 200 million listening events by about 16,500 Last.fm users, who hear over 1 million unique artists. Since the work hand focuses on fans of music genre, it yielded a group of 362 listeners. After performing five experiments per user, it had been found that random based was least precise, hybrid model was more precise than single based PB model was best in group of teenagers and overall hybrid of CF and IB gave best results.

Kunhui Lin et al. [8] proposed the employment of improved user- based collaborative filtering algorithm to cope with the user's long-term preferences. Then, in step with the user-tag-music relationships, getting the music that related to the user via recommendation algorithm supported bipartite graph is finished. For music personalized recommendation, the commonly used methods include content based recommendation technology, the collaborative filtering recommendation technology and hybrid recommendation technology, where hybrid is that the combination of the 2. The content based is on generating playlist supported the user's favorite music while the collaborative based in where each music comes with a tag, thereby recommending similar tag music to the user. there's use of k-means clustering algorithm to cluster users to fill user- music matrix, finding user of comparable music taste. The improved recommendation algorithm supported bipartite graph mainly uses information of user-tag two-dimensional relationship and tag-music two dimensional relationship. After testing it had been found that improved personalized music recommendation system was most accurate instead of user based collaborative model or recommendation supported bipartite graph.

Ms. M. Sunitha et al. [9] developed an Android application for music recommendations. the applying allows the user to pick out and hear the songs available in their device. Whenever a user listens to a specific song, a log is made, consisting of certain fields which identify the song. the basic style employed here is that of collaborative filtering. it's very hip and is being employed widely by companies like Amazon, Google, Yahoo, etc. Collaborative filtering methodology tries to seek out similarity between two users or items. it's independent of the attributes of these entities. Thus, collaborative filtering may be a content agnostic approach.

Kunal Shah et al. [10] proposed a good and diverse style of techniques for generating recommendations which include collaborative, content based, knowledge based and other techniques. These methods are blended in hybrid recommenders to boost performance. Collaborative filtering and content-based filtering approaches are extensively utilized in information filtering application. The hybrid approach used here involves individual implementation of collaborative and content-based methods and aggregation of their predictions to come up with recommendations. Integration of some pro characteristics from content based methods into a collaborative approach, integration of some pro characteristics from collaborative approach methods into a content-based approach is employed. A generic consolidative model that's the assimilation of both content based and collaborative characteristics is proposed.

III. PROPOSEDSYSTEM

The main objective of this work is to develop an application for music recommendations. the appliance allows users to pick and hear the songs available within the device.

Whenever a user listens to a specific song, a log is formed. so as to suggest songs to the users, we use various strategies to implement recommendation engine. the most motive of this Proposed System is extending the capabilities of the normal recommendation System. Traditional music recommendation systems rely on collaborative filtering or content-based filtering to come up with recommendations. Hybrid approaches combine the collaborative filtering and content-based filtering together to leverage the strengths and weaknesses of every approach. User modeling aims to develop an improved user profile. Context awareness associates users and items in a very specific circumstance like working or dancing. Tag-based recommendation labels items with users' opinions. Recommendation within the long tail tries to reduce the recognition bias and mostly accompanies collaborative filtering and for content-based filtering ignores item popularity. Recommendation networks introduces some new properties to the advice strategies. Playlist generation will be deemed as a variation of top-N recommendations, satisfying the requirements specified by users. Group recommendation involves some pre or post processing by either aggregating multiple user preferences into a unit user profile or uniting separate recommendation results into one recommendation list. a close model for music recommendation is as shown in fig. 2..

Fig. 2. A Detailed Model of Music Recommendation System

The system is split into three modules:

A. Recommendation Module: Recommendation module generates recommendation supported the user profile. It analyzes the previous listening history and preferences of a user and provides a listing of songs that user might favor to listen. we've got used a worldwide popularity model, Content based model and collaborative filtering model.
B. Digital computer Module:
We have implemented the digital computer using MongoDB, GridFS and NodeJS modules for efficient upload and retrieval of things. Grids for MongoDB provide many advantages over traditional classification systems such as: if the file system limits the amount of files in a very directory, we will use GridFS to store as many files as required. Information may be accessed from portions of enormous files without having to load whole files into memory. GridFS may be accustomed recall sections of files without reading the whole file into memory. we are able to keep the files and metadata automatically synced and deployed across variety of systems and facilities using GridFS. When using geographically distributed replica sets, MongoDB can distribute files and their metadata automatically to variety of MongoDB instances and facilities.
C. Web Application Module: Web application provides an intuitive programme to the user and interacts with digital computer and recommendation module.

III. MUSIC RECOMMENDATION APPLICATION

Popularity ModelIt is a basic model which sorts the songs within the training set in step with popularity in descending order and recommends most well-liked songs. This method doesn't takeuser's preference into consideration.

Content BasedModelContent-based filtering methods are supported an outline of the item and a profile of the user's preferences. These methodsare best suited to situations where there's known data on an item (name, location, description, etc.), but not on the user. Content-based recommenders treat recommendation as a user-specific classification problem and learn a classifier for the user's likes and dislikes supported product features. to form a user profile, the system mostly focuses on two kinds of information: model of the user's preference and history of the user's interaction with the recommender system. We implemented a K-Nearest Neighbor model to recommendsongs supported song metadata. First, we created space ofsongs supported different features within the metadata (artist, genre, etc.) so to recommend similar song. We select k nearestneighbors of the songs present within the user's profile. Ball Tree based nearest neighbor algorithm is employed to handle the computational inefficiencies of the brute-force approach. Ball tree algorithm partitions data during a series ofnesting hyper-spheres that ends up in an information structure which might be very efficient on highly structured data, even in very high dimensions. A ball tree recursively divides the info into nodes defined by acentroid C and radius r, such each point within the node

lies within the hyper-sphere defined by r and C. the quantity of candidate points for a neighbor search is reduced through use of Triangulum inequality. With this setup, one distance calculation between a test point and also the centroid is sufficient to see a lower and boundary on the space to any or all points within the node.

Collaborative Filtering ModelCollaborative filtering relies on the belief that folks whoagreed withinthe past will agree withinthe future, which they're going to like similar varietiesof items as they liked within the past. The system generates recommendations using only information about rating profiles for various users or items. By locating peer users/items with a rating history like the present user or item, it generates recommendations using this neighborhood. we've implemented item based collaborative filtering model. Listen count parameter is employed as implicit feedback for training. To calculate similarity between two items, we glance into the set of things the target user has rated and compute how similar they're to the target item i and so select K most similar items. Similarity between two items is calculated by taking the ratings of the users who have rated both the things and thereafter using the cosine similarity function as in (1).(1)

Once we've got the similarity between the things, the prediction is then computed by taking a weighted average of the target user's ratings on these similar items. The formula to calculate rating is extremely just like the user based collaborative filtering except the weights are between items rather than between users. We use this users rating for the item or for other items, rather than other users rating for the present items.

RESULTS

In this experiment, we were able to make a music recommendation system employing a hybrid approach of collaborative and content filtering. We were ready to play and recommend songs in four languages covering quite forty artists. To improvise the system, we asked the users about their preferences and that we also provided them with playlists of popular and latest songs. we've tested the system with a minimum of twenty users and also the results shown were quite promising. We received an accuracy of 96% on the music recommendation system.

IV. CONCLUSION AND FUTURE SCOPE

The experimentation is completed using twenty artists. within the future, we are going to attempt to add a greater number of artists and languages which is able to make the advice stronger giving even better playlists for the users. we are able to try the system with other machine learning models further to check the results and appearance for better results. When there are variant songs out there, our motive was to administer the users their preference of songs which they require to concentrate to and that we are satisfied after getting one step closer to that. For future applications, an emotional detector system that will recommend the songs by recognizing our facial emotion can be developed.

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