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An Innovative Solution for Personalized Music Application Using Machine Learning

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ABSTRACT
Various evolving machine learning algorithms are helping in generating personalized music applications on the basis of dataset generated through user history, favorites and so many other parameters. Some of machine learning algorithms such as cosine similarity, support vector machine, k nearest neighbor and k-means clustering etc. are widely used for preparing solutions for an effective personalized and user-friendly application. These algorithms can be used alone as well as hybrid with each other. In our project, we are using cosine similarity algorithm to find out similarity between choices of different users for collaborative filtering and also for finding similarity between different music factors such as favorite tracks, most played tracks and albums, favorite artists and similar data to make an effective content-based recommendation system.
Keywords: Cosine Similarity, Personalized Application, Content-based recommendation, Collaborative filtering, Machine Learning, K Nearest Neighbor, K Means Clustering.

I. INTRODUCTION

A recommendation system for music application is a machine learning based program that is used to recommend music on the basis of various parameters like user history, favorite, most played, search history etc. In this digital world, so many users using various music streaming platforms for their entertainment and it is so difficult to search music tracks. To overcome the problem of searching and finding desired tracks we use various machine learning algorithms that can be helpful to design personalized music applications. Some of the machine learning algorithms are K-Means Clustering algorithm, Cosine Similarity, K Nearest Neighbor, Random Forest that can useful to design effective recommendation system for personalized music application. These algorithms can be used alone as well as in hybrid method to make efficient music recommendation system. To make as effective personalized music application, we need to analyze the behavior and metadata of music dataset to apply the algorithms accordingly. Machine learning is helping to prepare solution for making content-based, collaborative filtering and hybrid recommendation system with its evolving algorithms. To make any collaborative filtering-based recommendation system, cosine similarity method is widely used to calculate the similarity between two or more than two users and on the basis of its result system can recommend music. And to make content-based personalized application, we need some important parameters like search history, play history, favorite tracks and artists etc. When combine both the systems than we get hybrid system that works effectively [1].

Most of the applications are using hybrid approach to make their system more effective and provide high performance and excellent experience to users. In our application we implemented cosine similarity algorithm of machine learning to find the similarity among various factors such as favorite albums, tracks, artists, playlists, play history, most played tracks etc. to recommend the tracks and to make the personalized and user-friendly application. We developed the application in python backend framework flask which handles the routing and requests of client application.

To develop the recommendation system, various languages can be used like python, java etc. Some programming languages have their own libraries that provided pre-built functions and modules so that no need to make modules again but in some programming languages we need to build modules. Python is one of the languages which is widely used to generate machine learning models and python have some pre-built libraries such as NumPy, Pandas etc. which are used for fast calculations on matrices, arrays etc. In these libraries of python, some in-built functions are present that can be helpful to calculate the desired calculations [2].

II. Literature Review

Since 1995, there is a 40% jump in the number of users who are using applications on worldwide. This increment of users is responding with a huge

amount of information and data that opening so many opportunities, but there is an increment in complexity of the applications and difficult to analyze this huge data. This complexity increases difficulty for user to make decision to find out best tracks from the application and due to this the performance of application is also reduce. To overcome the problem of complex decision making, recommendation systems were implemented that can solve any complex tasks and generate desired solutions without any human interaction. Users no need to use the traditional approach to find their favorite tracks, artists etc. Recommendation system will find your desired tracks on the basis of various music related parameters. Recommendation system a program that will make decisions after analyzing the dataset and will find best solution for you [1].

On the basis of complexity and requirements of the application there can be three types of recommendation system implementations which helps to make any music application personalized. These three recommendation systems are as follow:

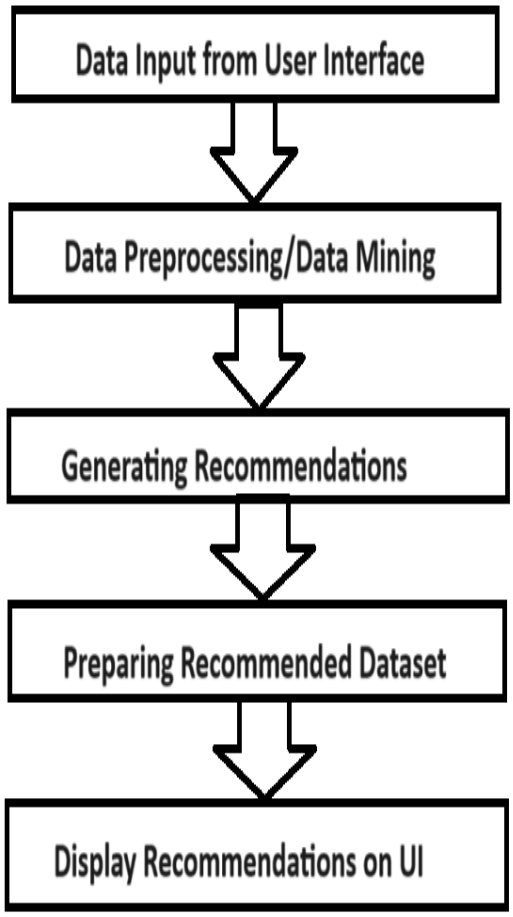
Content-Based Recommendation: System: In content-based recommendation system, results are generated on the basis of content that means if we are developing a music application with content-based methodology than the system will analyze the dataset on various parameters such as similar tracks, release dates, category of tracks, similar artists etc. This approach is commonly used in most of the music recommendation systems. To implement this method, we can use various machine learning algorithms such as cosine similarity, k-means clustering algorithm, random forest, support vector machine, k nearest neighbor algorithm and more. Each algorithm among these has their own benefits and limitations. Different applications can use these algorithms alone or hybrid on the basis of requirement [2].

Collaborative Filtering Recommendation System: In collaborative filtering-based recommendation system, recommendations are generated on the similarities between two or more than two users' choices and related data. In machine learning, there are so many algorithms that can be used to find out the similarities such as cosine similarity, K Nearest Neighbor, Euclidean distance, Hamming distance etc. After finding the similarity, the dataset of users whose similarity is more will be considered wo find out the recommendations for the user. Collaborative filtering method does not need to item details for providing recommendations, all the processing is based on similarities between users [2].

Hybrid Recommendation System: Hybrid recommendation is the combination of both Content-based recommendation system and Collaborative filtering-based recommendation system. Hybrid recommendation systems have its own advantages such as while using hybrid recommendation system performance of the music application increases and hybrid system generates the results on the basis of both type of recommendation system. Advantages of content-based and collaborative filtering-based recommendation systems are also advantage in hybrid system and makes the system more efficient to increase performance, optimize results, making complex decisions etc. Hybrid recommendation system can be implemented by various machine learning algorithms that can be used in content-based and collaborative filtering-based algorithms. Machine learning have so many powerful algorithms that can be useful on big dataset and generates efficient recommendation results [2].

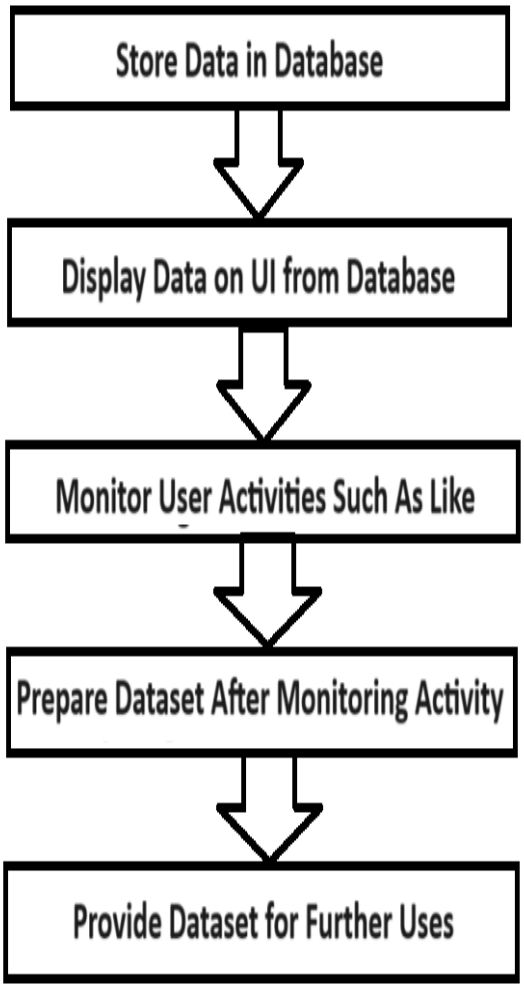
III. Methodology

I. System Architecture: Following are some steps involving to design personalized music application.



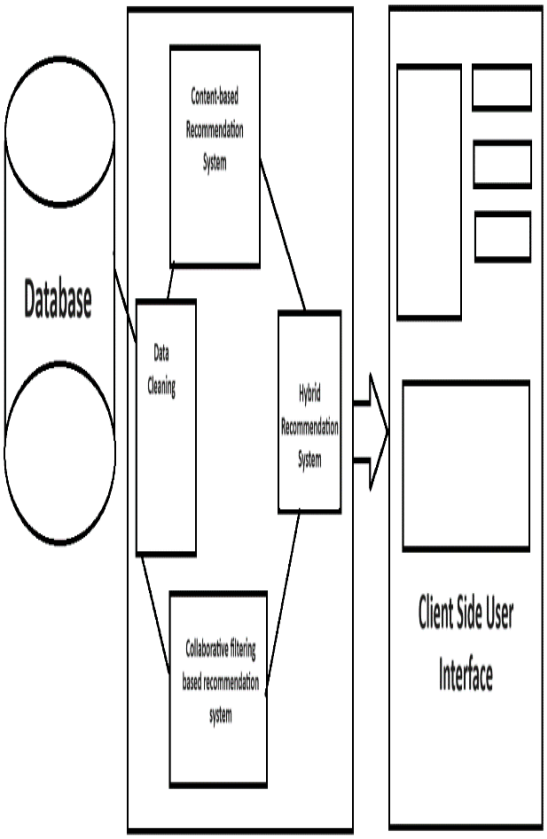
Data Input from User Interface: In this step, Application will collect the data from user interface. Music data will be from the year 1990 to march 2024 which includes music details, artists

details, music category details, music movie details, album details etc. After collecting this data into database, application will display it on screen and user will respond on it. On the basis of user responses such as which artists user liked, tracks that are liked by user, play and search history of user etc. application server will generate dataset for further processing and will store it in database. Below is the graphical representation for the data collecting process from user and database and storing for further uses:



Data Preprocessing/Data Mining: This is the step in which application will take data from database for preprocessing and will filter it. Data mining is the process to prepare the data as per the requirements of recommendation system. If we use data without preprocessing then the recommendation system may generate undesired results. Data mining is the process to extract useful data and leave the unnecessary data because that unnecessary data can cause crash in the music application and also decreases the performance of the application. Data mining process includes data cleaning, data integration, data transformation, normalization and feature selection etc. Data mining process uses the machine learning techniques, statistical techniques and computational techniques to analyze large datasets. While preprocessing the data, the important thing is that the data should be suitable for application and also satisfies the requirements for application because this data will be used to take the decisions in runtime environment of application [3].

Generating Recommendations: In this step, application will prepare actual recommendations on the basis of received dataset from previous step after refining. Below given the architecture to design personalized music application with content-based method, collaborative-filtering based method and after combine it to make hybrid recommendation system for personalized music application.



Database: Database is used here to store data of music and related information which is well defined and managed. To design the database, various SQL queries can be used also various database management terms can be used such as normalization, relations among objects, transaction etc. These concepts can be used to manage and manipulate database. Data from database can be clean and refine as server of the application.

Server: Server is the important part to render application templates and to handle various other

tasks such as handling client request, performing calculations, performing operation on database and preparing results for recommendation system. For the purpose of generating recommendations server will perform following tasks:

A. Firstly, dataset will be generated through preprocessing of data received from database.

B. When the data is pre-processed and cleaned then data is ready to prepare for recommendation system.

C. When generating collaborative filtering-based recommendation system, server will implement K Nearest neighbor algorithm to find the nearest similar data among multiple users and can also use cosine similarity algorithm to find similarity and provide recommendations for those who are more similar to each other.

D. When generating content-based recommendation system, server will take preprocessed dataset and will use K Nearest Neighbor algorithm, K Means clustering algorithm, Random Forest algorithm etc. to find out the similarity among various music related parameters such as tracks, artists, music release date etc. after it the final results can be generated.

E. After generating content-based and collaborative filtering-based algorithms server can combine results of these two methods to develop hybrid recommendation system which can be helpful to generate effective and efficient personalized music application with high performance.

F. In last step, data can be used on client-side user interface.

Preparing Recommended Dataset: After receiving dataset from previous step, now the dataset needs to prepare according to the client-side environment to use with client UI. In this step, dataset go through the various steps to filter out the data and prepare accordingly. In this step, dataset can be prepared as an excel sheet that can be directly used in application as well can store in database so that any manipulation in the data can be performed easily and efficiently. This dataset includes all the relevant information about music and in this dataset each and every information described as per application requirements. After preparing dataset with required and relevant information server process this data for client user interface [4].

Display Recommendations on UI: When server done with all the processing steps and generate the dataset for personalized recommendation then it's time to display those recommendations on user interface. On user interface, there are so many operations to perform such designing of user interface, encoding and decoding of audio file, encoding and decoding of image file, implementing event listeners to play music and other related information that should be displayed on screen. This is an important and main task to manage user interface according to recommendations that means user interface should show that music and artists first that are recommended by the recommendation system to increase the performance and efficiency of the music application and also to achieve personalized music recommendation application [5].

IV. Conclusion

This paper presented the hybrid approach to solve the problem of personalized music recommendations in which we use both types of recommendation systems content-based recommendation system and collaborative filtering method and after getting the result of these two methods we combined the results to get hybrid results which is helping to make an efficient personalized music application. In this paper we implemented cosine similarity algorithm and K Nearest neighbor algorithm to find nearest and similar data among users as well as music parameters and on the basis of it our recommendation system is generating hybrid results. This paper explaining how to make a personalized recommendation system to reduce human efforts to find their desired tracks and also helping to increase application accuracy, efficiency and performance with personalized application environment. Music applications significantly affect the music business and the manner in which we consume, find, and offer music. With their creative elements, customized proposals, and worldwide come to, these applications have changed the music listening experience for a huge number of individuals around the world. As innovation keeps on propelling, we can anticipate that music applications should turn out to be significantly more vital to our lives, molding the eventual fate of music utilization for a long time into the future. We might see music applications keep on advancing into more extensive diversion stages, integrating different types of media, for example, digital recordings, public broadcasts, and live occasions. This coordination of various kinds of content will give clients a more vivid and connecting with diversion experience, further setting the job of music applications in our regular routines.

5.Future Scope

Music streaming applications have turned into a vital piece of our lives, offering accommodation, assortment, and availability to music sweethearts around the world. As innovation keeps on

propelling, the fate of music streaming applications looks encouraging, with a few key patterns forming their development. One of the huge patterns coming soon for music streaming applications is personalization. Applications are progressively utilizing calculations and AI to comprehend clients' music inclinations better. They can suggest new music in view of listening history, make customized playlists, and propose custom-made proposals, upgrading the general client experience. Apart from these things, in future music factors for recommendations may be developed and some new factors can be major factors for the recommendations. In current scenario, recommendation results are generating on the various factors such as favorite, play history, search history, choice similarity etc. but future will be full of artificial intelligence and machine learning and new algorithms and techniques will be evolved. It may possible to generate recommendations on the basis of comments on tracks and user logs activity that can be analyze and monitor by artificial intelligence algorithms. In future, those music application who are not using machine learning will also use it to grow their business and application efficiency.

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