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MUSIC RECOMMENDATION USING MACHINE LEARNING ALGORITHMS

[1]Arjun Parthasarathy
Department of Computer Science and Engineering
Faculty of Engineering and Technology
SRM Institute of Science and Technology,Vadapalani, Chennai, India

Abstract: This research introduces a thorough approach to music recommendation by employing multiple algorithms such as k-Nearest Neighbours (kNN), Logistic Regression, Support Vector Machine (SVM), Random Forests, and Cosine Similarity for content-based filtering on the Spotify dataset. The program evaluates the effectiveness of these algorithms in generating a "similarity score" for each song based on its acoustic features, such as acousticness, danceability, energy, and tempo, among others. These algorithms are assessed to determine which one provides the most accurate music recommendations. When given an artist's name and a selected song as input, the program calculates similarity scores using each algorithm to find the top 5 songs that are most similar to the input song. By comparing and contrasting the outcomes of these algorithms, the research aims to identify the most effective approach for creating personalized playlists based on users' music preferences.

Keywords: Content-based Filtering, Recommendation System, Algorithm Comparison, k-Nearest Neighbours (kNN), Logistic Regression, Random Forests.

1. Introduction

Music is considered a universal language that goes beyond cultural and geographical boundaries. In modern society, music streaming platforms have revolutionized the way media is consumed.

The platforms' vast libraries help curate a user's music with ease, but with too much variety come drawbacks – it leaves users confused. While giving users more control over what they listen to, the overwhelming abundance of music makes it harder for users to find what they like. Taking this scenario into consideration, the significance of a music recommendation system becomes increasingly clear.

Music recommendation systems have a significant role to play for several reasons. It streamlines music selection processes for users by providing tailored song recommendations from a vast catalogue. The platforms benefit from utilizing these systems to actively provide recommendations as they help in user retention and acquisition. These systems can receive further enhancements by incorporating mood or activity-based song filtering.

The objective of this research is to focus on Machine Learning Algorithms and how they are utilized in music recommendations. These algorithms are used to analyse a wide range of data to generate personalized song suggestions based on audio characteristics. Doing so ensures that users can discover music that reflects their individual tastes.

This introduction highlights the significance of music recommendation systems, the benefits they bring, and the role of Machine Learning Algorithms in making music discovery and recommendations more effective.

2. Literature Survey

Anthony et al.'s [1] study explored the application of One Hot Encoding and Term Frequency-Inverse Document Frequency (TF-IDF) in music recommendation. Their research provided valuable insights into designing effective music recommendation systems. However, an examination of their study reveals several gaps that require improvement.

First, Anthony et al. focussed on three main features for prediction: popularity, energy, and liveness. It is imperative to note that these features may not be the most relevant for the task of music recommendation. Popularity solely reflects the track's popularity. Energy measures how fast, loud, and noisy a song is, and liveness detects the presence of an audience. This narrow set of features may not entirely capture the diversity in user preference.

Second, in their study, they have applied TF-IDF to process audio features, which is traditionally used in text-based information retrieval. TF-IDF may not fully accommodate the complexity of audio features used for music recommendation.

The work of Rajesh Kumar and Rakesh [2] involved the creation of an intelligent music recommendation system using the K-means clustering algorithm. A careful analysis of their work revealed gaps that require enhancement.

The K-means clustering algorithm has a disadvantage in clustering diverse data. It does not provide versatility when handling datasets with different types of data - numerical, categorical etc.

In their work, the absence of a personalized recommendation approach is noted. The K-means clustering algorithm segments songs into clusters with similar attributes, and it does not consider the individual preferences of users.

Their research does not provide a solution to the cold-start problem. K-means algorithm may not provide meaningful recommendations to songs without historical data.

2.1 To Address Gaps in Anthony et al.’s Work

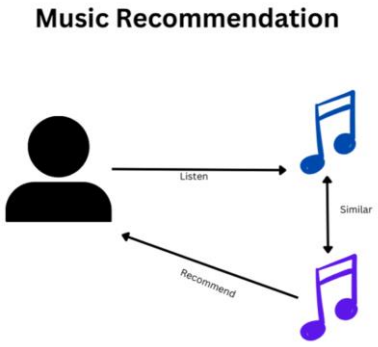
1. Enhance Feature Engineering: By expanding the range of features considered in the recommendation system, it offers a more comprehensive and accurate recommendation.
2. Improving Feature Engineering: The usage of TF-IDF revealed a discernible gap. To address this, Machine Learning Algorithms are employed to enable a more robust representation of audio features.

2.2 To Address Gaps in Rajesh Kumar and Rakesh’s Work

1. Machine Learning Algorithms for Handling Diverse Feature Types: The limitations of the K-means algorithm in handling diverse features are overcome by utilizing MLAs capable of effectively handling these features.
2. Personalizing Recommendations: MLAs that consider user interactions are utilized. This allows for a more personalized approach to recommendations.

3. Methodology

Music Recommendation Systems aim to provide users with personalized song suggestions to enhance their listening experience. In this system, genre-based filtering is implemented to suggest songs similar to a given track within the same genre.



3.1 Model Architecture

The Model Architecture as illustrated in the diagrams, outlines a framework for the music recommendation system. A Spotify database containing over a million songs has been utilized for data collection. The architecture includes multiple individual models, each described by the corresponding flowcharts illustrating the implementation.

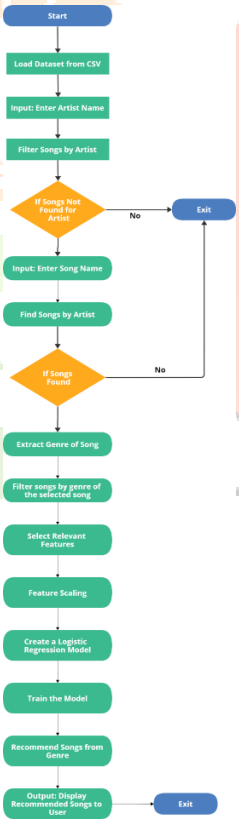


Fig. 2 – Workflow of Logistic Regression Model

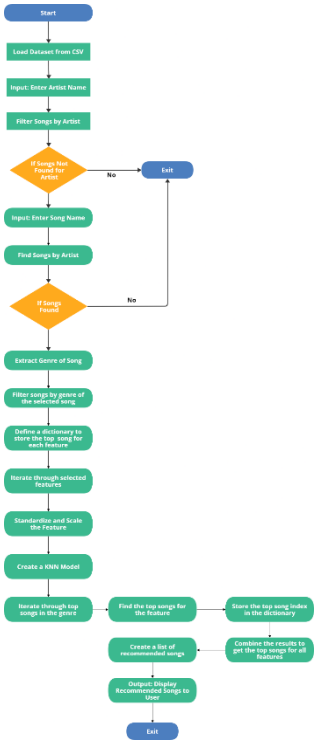


Fig. 3 – Workflow of KNN Model

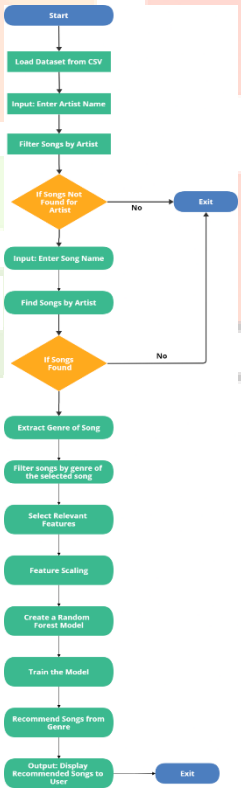


Fig. 4 – Workflow of Random Forest Model

3.2 Data Preprocessing

Data Preprocessing is the first step and the most important step in this process. The dataset is sourced from Kaggle and is prepared to be used in the recommendation system. The Pandas library in Python is used to load and preprocess the dataset. Following are the methods used to preprocess and load a dataset for music recommendation.

3.2.1 Data Loading

The dataset is saved as a CSV File. The dataset comprises of over 1 million songs and has a diverse set of features.

3.2.2 Feature Selection

Only features that have been deemed relevant to the recommendation process are chosen. The features include 'acousticness', 'danceability', 'energy', 'instrumentalness', 'key', 'liveness', 'loudness', 'mode', 'speechiness', 'tempo', 'valence' and 'genre.' These features play a vital role in determining the quality of recommendations.

3.2.3 Normalization

The selected features are all normalized. StandardScaler from the scikit-learn library is used for this task.

3.3 User Interaction

User interaction is an important element in a recommendation system as it personalizes a user's suggestions. Permitting users to interact with the program will help enhance the recommendations. These are the methods used to promote user interaction.

3.3.1 User Input

Providing users the opportunity to input the name of an artist and a song of their choice improves the overall user experience. By doing so, the tailored recommendations fall more closely to the inputs.

3.3.2 Filter Criteria

When the user is asked to narrow down the input, the model retrieves the songs that abide by the criteria put forth by the user. This assures the alignment of input and output.

3.4 Recommendations

This section explains the process for generating recommendations based on user input and the algorithm available.

3.4.1 Genre Determination

The important step is whether the system can determine the genre of the input song. This is done to ensure that the recommendations are accurate.

3.4.2 Feature-based Recommendation

For each feature selected from the Preprocessing step, the system utilizes the different MLAs employed to identify and display songs that have similar features.

3.4.3 Visualizations

A histogram denoting the distribution of similarity scores for recommended songs:

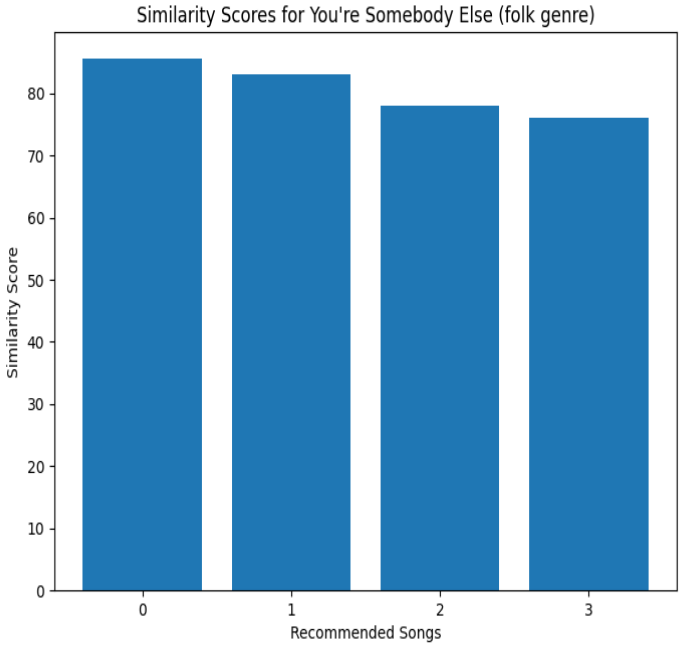


Fig. 5 - Histogram

A heatmap illustrating the pairwise similarity scores between the input song and recommended songs:

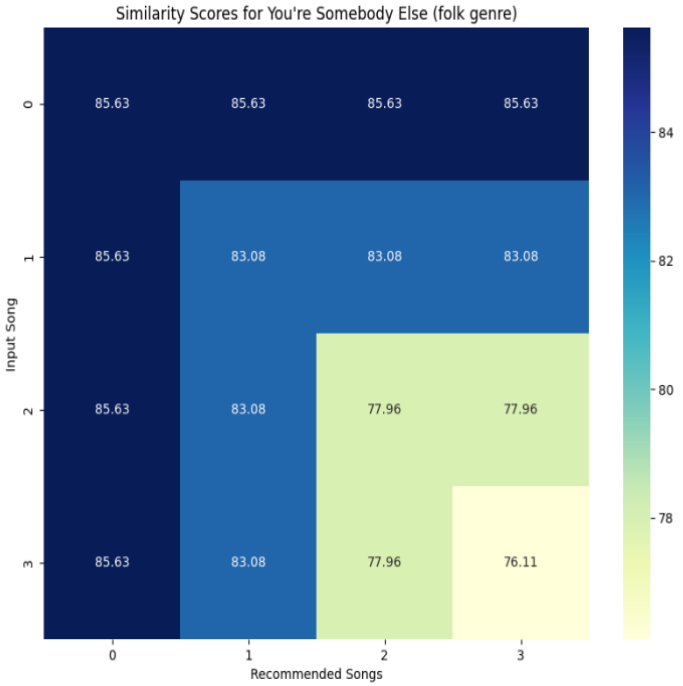


Fig. 6 – Heatmap

4. Results

The recommendations are sorted in descending order of their similarity score and the five top-rated songs are returned to the user as output. Each recommendation includes artist's name, song title, genre, and the similarity score expressed as a percentage.

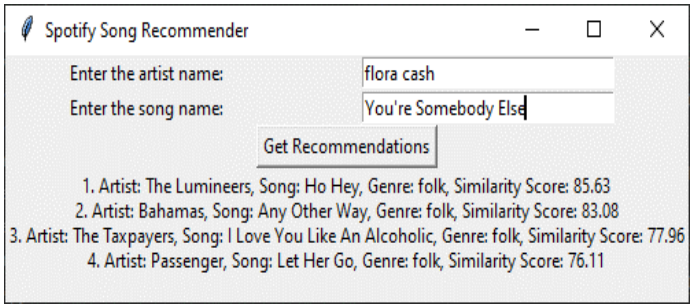


Fig. 7 - Results

5. Conclusion

The implementation of music recommendation system has successfully provided personalized song suggestions for users based on a selected track within the same genre. The system has utilized feature-based analysis, user interaction, and data visualization to complement the recommendations.

6. Future Enhancements

This study explores the possibility of future enhancements and optimizations by integrating user feedback, and exploration of advanced machine learning techniques and algorithms for recommendations.

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