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Music Recommendation System Based on Artist Relatedness and Audio Similarity

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Abstract: ***The automatic music recommendation system has become an increasingly relevant problem in recent years, along with the increasing amount of music circulating in digital format.In this research, music recommendations are sought by searching for music that is similar to music input, using value of music features with K-Nearest Neighbor method. Artist relatedness also be used in this research to get music recommendations, so that the recommendations are suitable with the listener's preferences. Spotify API which is provided by Spotify, an online music platform is used in searching music features and artist relatedness in this research. The method used to calculate audio similarity is K-Nearest Neighbor (K-NN). Based on evaluation result, music recommendations that only use artist relatedness features have a higher precision value compared to music recommendations that use combination of artist relatedness and audio similarity, because the research participants were more likely (subjectively) to choose popular music compared to music that has similar audio with input music.***

Keywords:artist relatedness, audio similarity, k-nearest neighbor, music recommendation, Spotify API

1. Introduction

A recommendation system helps the user to select the appropriate item and ease the search for selected items in a large collection of items[1]. The music recommendation system can help users find music from a large music database.

The automatic music recommendation system has become an increasingly relevant problem in recent years, along with the increasing amount of music circulating in digital format. Music recommendation systems commonly rely on collaborative filtering techniques that use a combination of music that is listened to or music ranks in giving recommendations. This technique has problems in recommending new music which is never been heard or rated by the music listeners [2].

In this research, music recommendations are sought by searching for music that is similar to music input, using value of music features with K-Nearest Neighbor method. Artist relatedness also be used in this research to get music recommendations, so that the recommendations are suitable with the listener's preferences. Spotify API (https://developer.spotify.com/web-api/) which is provided by Spotify, an online music platform is used in searching music features and artist relatedness in this research. The method used to calculate audio similarity is K-Nearest Neighbor (K-NN); the method is used in this research because it is simpler when compared to the artificial neural network used by [3]and produces higher accuracy results as shown in research performed by[4].

Although online music providers such as Spotify and Deezer have provided various playlist and recommendations, a specific music recommendation based on the artist relatedness and audio similarity have not been provided. The aim of this research is to develop a music recommendation system that uses the combination of artist relatedness and audio similarity, which are expected to increase recommendation precision value.

2. System Overview

The system is implemented in the form of a website, so that the system users can access it simultaneously from different places with internet connection. The input given by the user to the system is a music title or artist and the output received by users is a playlist consist of 20 pieces of music that are similar to the music input based on artist relatedness and audio similarity. The system overview is shown in Figure 1.

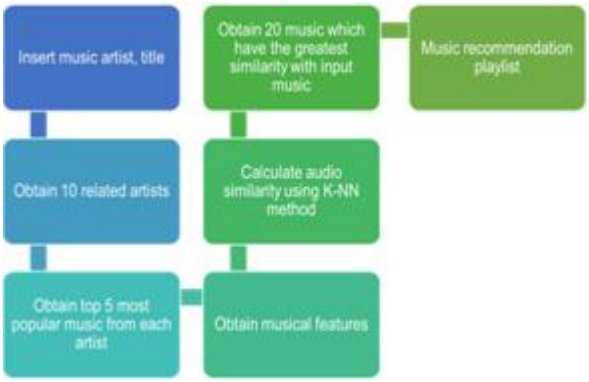

Figure 1: System Overview

The first step is the user gives an input in the form of music title or artist. After the system receives input, the system will search for 10 artist related with the input artist. Of the 10 related artists, the system will choose the 5 most popular pieces of music (which have the most listening counts in Spotify). The total music obtained at this stage is 50 pieces of music. Each music feature of the 50 music is obtained and the similarity is calculated using the K-NN method. A total of 20 pieces of music with the greatest similarity will be used as music playlist that can be played online.

3. Research Methods

The research is done with 50 participants consist of college students in the age range of 19 and 22. This section explains how the data is collected, feature selection method, how the

artist relatedness connect artists, K-NN method, and system evaluation method.

3.1 Data Collection

Spotify API uses music feature data from Echo Nest. Echo Nest uses signal processing and machine learning to extract all features in music. This machine learning technique simulates how people hear music, combines the principles of psychoacoustics, musical perception, and adaptive learning to model physical and cognitive processes of human hearing. There are 11 different music features that can be retrieved by the Spotify API. These features are represented by numbers, with different ranges. Available features are danceability, energy, key, loudness, fashion, speechiness, acousticness, instrumentalness, liveliness, valence, and tempo.

3.2 Feature Selection Method

Not all features provided by Spotify (11 music features) were used in this study. The Sequential Forward Selection method is used to select music features. The main purpose of feature selection is to find the optimal subset of a full set of features, to get features that provide relevant information to adjust or improve classification accuracy.

The Sequential Forward Selection (SFS) algorithm is a bottom-up search procedure that starts from an empty set and gradually adds features chosen by several evaluation functions[5]. In each of iteration, the features to be included in the feature set are selected from the remaining features available from the feature set, which have not been added to the feature set. So, the new extension features that are specified must produce smaller classification errors when compared to the addition of other features. SFS is used because of its simplicity and speed [6].

3.3 Artist Relatedness

The association of artists obtained using the Spotify API is based on the listening history of Spotify users. Artists associated with other artists show that the artist has something in common. This allows us to see that users who listen to The Rolling Stones a lot, for example, are also big fans of Iggy Pop or The Byrds.

3.4 K-Nearest Neighbor

K-Nearest Neighbor (K-NN) algorithm is a method for classifying objects based on learning data that is the closest to the object. The K-NN algorithm calculates the distance (or similarity) between each test data and all initial data to calculate the list of its nearest neighbors [7]. The distance used between each test data and all the initial data is the Euclidean distance shown in (1) with x and and y is the test data and initial data, n is the number of dimensions, x_k and y_k are the k-attributes of x and y.

$$D_{(x,y)} = \sqrt{\sum_{k=1}^{n}(x_k - y_k)^2} \quad (1)$$

3.5 System Evaluation Method

This system evaluation is carried out with 50 research participants who tried the system by giving input Indonesian music and International music. System testing is done by finding the accuracy/suitability of music recommendations that have been generated by the system based on the user's assessment by calculating precision values using equation (2)[1].

$$Precision = \frac{tp}{tp+fp} \quad (2)$$

True positive (tp) on information retrieval is a relevant item generated by the system as a recommendation. While the false positive (fp) is an irrelevant item generated by the system as a recommendation.

The suitability of the results of recommendations with input music is determined subjectively by each study participant, based on the suitability of the music atmosphere, musical genre, and general knowledge of each participant.

4. Research Result

The research results described below are consist of the selected music features, user interface result, and system evaluation result.

The selected features are acousticness, loudness, energy, danceabiliy, speechiness, valence, tempo, fashion, and liveliness. The excluded features are instrumentalness and key. The instrumentalness feature predicts that music contains vocals (singer's voice) or not, while the key feature is the key used in music (C, C #, D, etc.).

The system interface consists of one page that can be accessed by all system users. One page of the interface consists of two main parts, namely the music input section and the recommendation section.

Figure 2 shows the recommendation system's user interface, with music from Dua Lipa titled New Rules as input music and a display of 3 music recommendations (out of 20),namely Call Me Maybe by Carly Rae Jephsen, Dance to This from Troye Sivan, and Fifth Harmony's Worth It.

System evaluation result obtained the following precision results: Recommendations based on International artist relatedness= 0.82, recommendations based on Indonesian artist relatedness = 0.74, recommendations based on artist relatedness and audio similarity (international) = 0.79, (Indonesian) = 0.69.

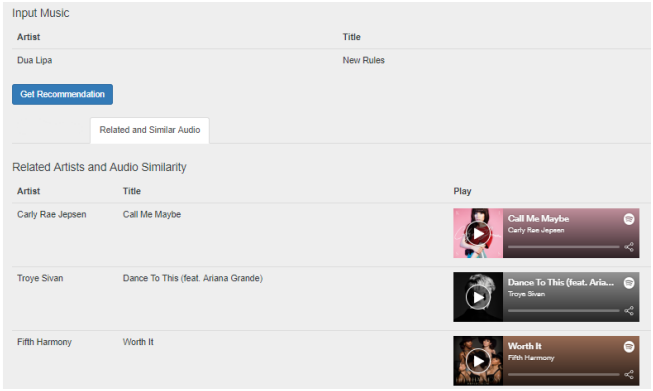

Figure 2: User Interface

Based on evaluation result, music recommendations that only use artist relatedness features have a higher precision value compared to music recommendations that use combination of artist relatedness and audio similarity. Figure 3 shows a comparison of the value of precision music recommendations.

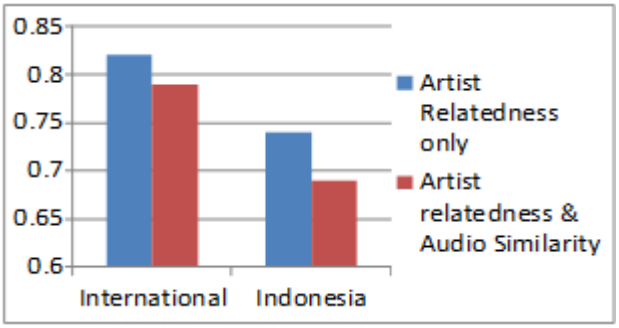

Figure 3: Precision Value Comparison

The difference in precision values in International music categories is 0.03, while in the Indonesian music category the difference is greater, that is 0.1. In general, the value of precision recommendations for foreign artists is higher than Indonesian artists.

Music recommendations based solely on artist association (R1) can get a higher value than the combination of artist relatedness and audio similarity (R2) because on R1, the music taken for recommendation is only 2 pieces music with the highest popularity without considering audio similarity. Whereas on R2, 5 pieces of music with the highest popularity were taken, after which the audio similarity was calculated. Music with the highest popularity does not always have audio features (acousticness, loudness, energy, danceabiliy, speechiness, valence, tempo, mode, and liveliness) that are similar with the input. Research participants were more likely to choose popular music compared to music that has similar audio with input music.

5. Conclusion and Suggestion

A recommendation system based on artist relatedness and audio similarity has successfully built using Spotify API. Music recommendations which only use artist relatedness features have a higher precision value comparing with the combination of artist relatedness and audio similarity. This means that the research participants were more likely to choose popular music from artists related to music input compared to music that has audio similarities from artists related to music input.

The difference in precision values in International music categories is 0.03, while in the Indonesian music category the difference is greater, that is 0.1. In general, the value of precision recommendations for foreign artists is higher than Indonesian artists.

In further research, music recommendations can be more personalized with context data such as personal data and listening history from listeners so that recommendations can be more suitable with the preferences of listeners.

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