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Music Recommendation System using Case-Based Reasoning Method

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Abstract: ***The choice of music in the playlist may differ according to the activities carried out at a certain time. A music recommendation system that can simultaneously create playlists for users based on certain activity and/or mood can reduce the time it takes for music listeners to find suitable music and make music playlists to listen to. In this research, the music recommendation system will use listening history data from music listeners and the Case-Based Reasoning method. Music listening history data consists of listener context data (gender and age), music data (artist and title), and other context data (time, desired mood, current weather, and activity). Context data is used because the latest developments in recommendation systems and music information retrieval have shown that context data is important data that can produce personalized recommendation results. The Case-Based Reasoning methodgenerates recommendations by selecting the listening history data that is in accordance with the current state of the listener. System evaluation was carried out and obtained a 0.66 precision value based on user preferences, which indicates that 66% of the recommendations provided by the system are suitable for the user.***

Keywords: case-based reasoning, context data, listening history, music recommendation

1. Introduction

The choice of music in the playlist may differ according to the desired mood and activitiescarried out at a certain time. When resting, the music choices tend to have a slow tempo, while during walking or running, the music choices tend to be in a fast tempo. Currently the amount of music in circulation is very large and music listeners can spend a long time choosing music that is suitable for listening to certain activities and times. Instead of creating playlists manually, music listeners prefer playlists that are generated automatically[1]. To meet the needs of easy making or easy accessed music playlists, there are a lot of composed playlists which can be accessed through online music platforms, but those playlists are not personalized enough to fit someone's favorite taste of music.

A music recommendation system that can simultaneously create playlists can reduce the time it takes for music listenersto find suitable music to listen to. The recommendation system should be able to know the user's music preferences and choose music based on those preferences. Various researches have been conducted to obtain music recommendations with different methods and data. [1] uses music listening history data and analyzes music that is always selected simultaneously with linear regression. [2] also used music listening history data to produce music recommendations based on the cultural backgrounds of listeners who came from different countries.

In this research, the recommendation system will use listening history data from music listeners and the Case-Based Reasoning method. Music listening history data consists of listener context data (gender and age), music data (artist and title), and other context data (time, desired mood, current weather, and activity). Context data is used because the latest developments in recommendation systems and music information retrieval have shown that context data is important data that can produce personalized recommendation results [2].

The Case-Based Reasoning (CBR) method will generate recommendations by selecting the listening history data that is in accordance with the current state of the listener based on the context data provided. The CBR method is used in this study because it can provide solutions for new cases by using solutions from previous cases which are similar to new cases [3]. This is suitable for recommending music based on listening history data. The listening history data will be used as previous cases or old cases in the system's general knowledge, which can provide solutions to new cases (music recommendation request).

2. System Overview

This music recommendation system was built in the form of a website. It can be accessed online through a browser on a computer, laptop, or smartphone. Figure 1 shows an overview of the system's general workflow that can be seen from the user's side. When using the system for the first time, users are required to fill in data on the register form consisting of username, password, age, and gender. Username and password are used to log in the system. Once logged into the system, the user needs to enter the current activity, desired mood, and current weather to generate a music recommendation playlist. Meanwhile, the listening date and time has been recorded automatically by the system.

After the activity, desired mood, weather, and time data are received by the system, it will create a playlist of music recommendations obtained using the Case-Based Reasoning method. The playlist consists of 20 pieces of music that are suitable for the user based on the context data received and recorded by the system. This system will make a playlist consisting of music title, artist, and a music preview. The

music preview is obtained from Spotify using Spotify API.

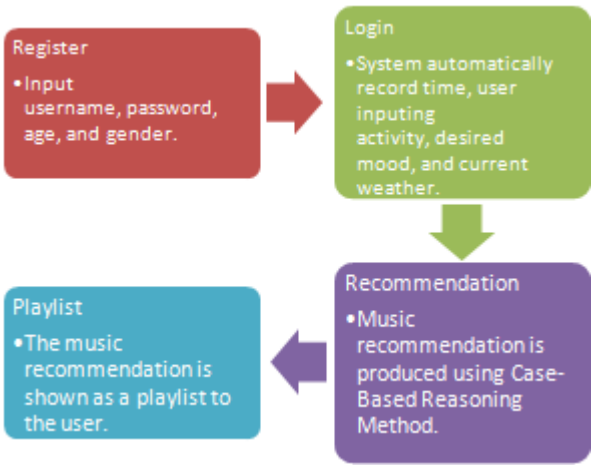

Figure 1: System overview

3. Research Methods

3.1 Dataset

Listening history data is a collection of data in the form of a title-artist-time pair of music that was listened to by the listener for a certain period of time. In addition to title, artist, and time data, music listening history data can be added with other data, such as listener data, music data, or context data.

Data used in this research consist of listener context data (gender and age), music data (artist and title), and other context data such as time (morning, afternoon, dusk, evening, and dawn), desired mood (happy, relaxed, sad, and anxious), current weather (clear, partly cloudy, cloudy, raining, and heavy rain), and activity (relaxing, studying, working, driving, and exercising).

The initial data collection process to obtain old cases data was carried out with 5 research participants who would record listening history data in the form of titles, artists, time, activities, desired moods, and weather for 2 months. There were 626 listening history data recorded as old cases. New case data is obtained from 30 research participants who will seek recommendations based on time, activity, desired mood, and weather. There were 180 data recorded as new cases.

3.2 Case-Based Reasoning

Case-Based Reasoning (CBR) is one method used to build an expert system. A case is basically an experience of a problem that has been solved. This can be represented in a number of ways. A case base or system's general knowledge is a collection of cases that have been resolved. So that CBR is an approach that is intended to solve a new problem using old experiences or cases that have been previously resolved [4]. To find the solution of a given new case, the system will look for old cases on the case base that have the highest degree of similarity to the new case.

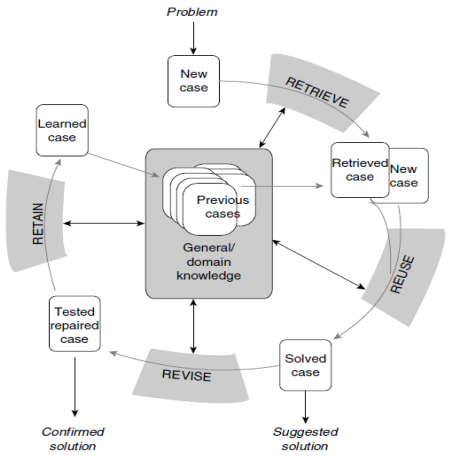

Figure 2: The process cycle of Case-Based Reasoning [5]

CBR is usually described as a cycle process consisting of four REs: (1) REtrieve: taking a case similar to a new case, (2) REuse: reusing information and knowledge in this case to try to solve a problem, (3) REvise: improve the proposed solution if necessary, and (4) REtain: save parts of the case that may be useful for solving cases in the future [6]. Figure 2 shows the process cycle of four REs.

3.3 System Evaluation

System evaluation is done by calculating the accuracy/suitability of the music recommendations that have been produced by the system based on the user's preferences. The user will assess the suitability of the recommended music based on personal judgement (subjective). The evaluation of each music playlist is done by calculating precision value using equation (1).

$$Precision = \frac{tp}{tp + fp} \quad (1)$$

True positive (tp) on information retrieval is the relevant item generated by the system as a recommendation. In this study, relevant items are music recommendations that are suitable to the user's preferences. Meanwhile, the false positive (fp) is an irrelevant item generated by the system as a recommendation or a music that is not suitable to the user's preferences.

System testing was carried out with 30 research participants. The listening history data or old cases were recorded from 5 of them. All participants in the system evaluation used the music recommendation system 6 times at different desired moods, weather, activities, and times. The total testing data collected is 180 records.

4. Research Results

4.1 Case-Based Reasoning Implementation

Case-Based Reasoning (CBR) was implemented in four stages, namely the retrieve, reuse, revise, and retain stages. These four stages were implemented using Laravel framework. The retrieve stage calculates the similarity of the new case to the old case in the database (case base/general knowledge). Equation (1) is used to calculate the similarity

of each feature in cases. The reuse stage is where old cases are reused to solve problems in new cases. In this research, the aim is searching for music recommendations, so that the solution offered is not only one but twenty different pieces of music which will later be displayed in the form of a music playlist. In the reuse stage, the similarity values calculated in retrieve stage were sorted and 20 music which had the highest similarity score were chosen.

The revise stage is where old cases solutions collected from the previous stage are evaluated and revised. Solution of old cases should be revised if the old case had similarity score less than 0.5 to the new case. The solution will be replaced with one of the user's recently heard pieces of music. The retain stage saves the newly edited solution in the previous stage to the case base if the listener approved that the solution is suitable.

4.2 User Interface Implementation

The system interface is implemented in accordance with the design that has been made. There are four user interface web forms that can be accessed by users, they are login form, register form, recommendation form, and edit profile form.

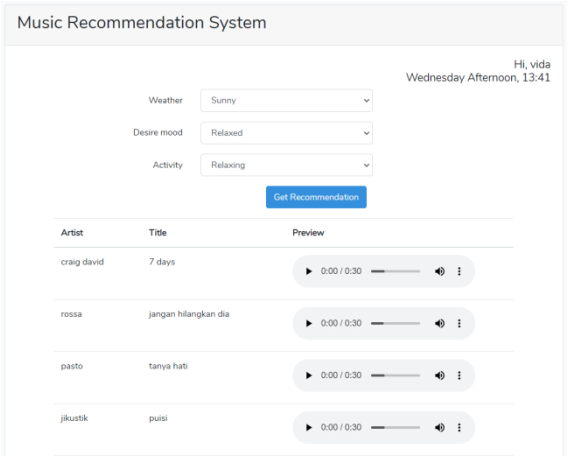

Figure 3: Recommendation form user interface

Figure 3 shows the recommendation form user interface. Users must input the current weather, desired mood, and current activities to get music recommendations. The recommendation resultswere shown in a tabular form consisting of artist name, music title, and a 30 seconds music preview.

4.3 System Evaluation Result

Figure 4 shows the average precision value of each user's music recommendation. The highest average precision value is in user number 8 with a value of 0.81, while the lowest average precision value is 0.48 for user number 13. The average overall precision for music recommendations is 0.66, which states that 66% of system recommendations result is compatible (subjective) with the user preferences.

There were 34% of recommendation results which were subjectively not approved by the user. The problem was the genre of music in the recommendation result was not favored by the user. These genre preferences should be added to user context data to eliminate music from unfavorable genres. The precision value will be higher if the users or system testers try to get more recommendation (more than 6 times) so that the system will get more input in the form of approved revised solution in the retain stage from the user. The more variated the case base, the more old cases will probably have a greater similarity value to new cases.

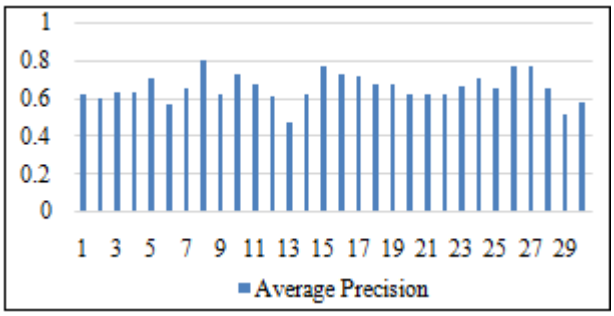

Figure 4: Average Precision per User

When evaluating the system, it was found that there were some recommended music results that the system could not load the music preview from Spotify.

5. Conclusion and Future Work

A music recommendation system can be built using the Case-Based Reasoning method and listening history as its case base. This research uses context data, namely gender, age, desired mood, time of listening to music, activities, and weather, as features in the old and new cases. The precision value based on user preference is 0.66 which indicates that 66% of the recommendations are in accordance with the user.

The precision value can be increased in the future works by multiplying the initial data (case base) so that the old case variations can have a closer resemblance to the new case and adding a genre preference feature to the user properties to prevent recommendations from unwanted genres.

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