

# Report on Music Recommendation System

## Introduction

This report documents the methodology and findings from the implementation of a music recommendation system utilizing audio data from the Free Music Archive (FMA). The system processes and analyzes audio features to recommend music tracks based on similarity measures. The objective is to evaluate the system's effectiveness and provide insights into its implementation.

## Methodology

The development of the music recommendation system involved several key stages, each contributing to the system's overall functionality:

### 1. Data Collection and Preparation

The audio files and corresponding metadata were sourced from the FMA dataset. The initial step involved setting up directories for storing the audio files and loading the metadata that describes each track.

### 2. Feature Extraction

Audio features were extracted from each track using the librosa library. The features include:

MFCCs (Mel-frequency cepstral coefficients): Capture the timbre of the sound.

Spectral Centroid: Indicates the brightness of the sound.

Chroma Frequencies: Relate to the pitch classes.

Spectral Contrast: Measures the sound's dynamic range.

These features were computed for each audio file, averaged over time, and compiled into a feature set representing each track.

### 3. Data Cleaning

Metadata was cleaned by removing irrelevant columns and filling missing values appropriately to ensure data integrity. This step was crucial for maintaining consistent and reliable data for analysis.

### 4. Database Integration

The cleaned data and extracted features were stored in MongoDB, a NoSQL database, facilitating efficient data management and retrieval necessary for the recommendation system.

## 5. Similarity Calculation

Cosine similarity was computed among tracks based on their audio features. This measure helps identify tracks that are musically similar, forming the basis for recommendations.

## 6. Recommendation System Implementation

Using the similarity data, the system recommends tracks that closely match the user's current listening preferences. This is achieved by selecting tracks with the highest similarity scores related to the user's last listened track.

## Findings and Evaluation

The effectiveness of the recommendation system was evaluated based on its ability to recommend tracks that are genuinely similar to the user's preferences. The evaluation criteria included:

**Accuracy:** How closely the recommended tracks match the audio features of the preferred tracks.

## Results

The recommendation system demonstrated a high degree of accuracy in matching tracks with similar audio profiles. Users reported satisfaction with the relevance of the suggested tracks, indicating that the feature-based similarity effectively captured the essence of their musical preferences.

## Performance

The system efficiently handled large datasets with minimal latency, thanks to the effective use of MongoDB for data storage and retrieval, and the batch processing approach for feature extraction and similarity calculation.

## Conclusion

The implemented music recommendation system effectively suggests tracks based on audio similarity, providing users with a satisfying listening experience that aligns with their preferences. The use of advanced audio processing techniques and efficient data management strategies contributed to the system's robust performance.