**VibeCraft**

**Submitted for**

**Statistical Machine Learning CSET211**

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A close-up of a logo

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**INDEX**

|  |  |  |
| --- | --- | --- |
| Sr.No | Content | Page No |
| 1. | Abstract |  |
| 2. | Introduction |  |
| 3. | Related Work |  |
| 4. | Methodology |  |
| 5. | Hardware/Software Used |  |
| 6. | Experimental Results |  |
| 7. | Conclusions |  |
| 8. | Future Scope |  |
| 9. | Github Link of whole project |  |

**ABSTRACT**

VibeCraft is a machine learning-based music recommendation system designed to suggest five songs based on a user’s input track. By analyzing the audio characteristics and patterns of the input song, the system identifies tracks with similar vibes, genres, and moods. VibeCraft uses clustering and distance metrics, such as cosine similarity, to ensure that the recommended songs are closely aligned with the original input, providing a personalized and engaging music discovery experience.

**INTRODUCTION**

With the increasing volume of music available online, personalized music recommendations have become essential for users seeking new tracks that match their taste. VibeCraft aims to address this by offering an intuitive system that suggests songs based on the musical characteristics of a single input track. The tool leverages statistical machine learning techniques, including clustering, dimensionality reduction, and distance metrics, to identify songs that align with the user's input in terms of mood, genre, and audio features.

**RELATED WORK**

Ms. P. V. Shitole introduced Emo Player as an ingenious solution that allows users to automatically play songs based on their moods. It analyses the user's facial expressions and plays music that matches those emotions. The emotions are identified using a machine learning technology called the SVM algorithm. The outer component may be a necessary component of an individual's body, and it plays a significant role in bringing out an individual's behaviours and feelings. The camera captures an image of the user. It then extracts the user's countenance from the captured image. Facial expressions are divided into two types: smiling and not smiling. According to the impression, music square measure competes with prearranged directories.

According to another study, "Melomaniac-Emotion Based Music Recommendation System," the most demanding aspect of listening to music depending on our mood is selecting the accurate tune, which can be solved by using pragmatic CNN techniques that reliably distinguish users' moods. The Facial Expression Recognition system should identify issues such as face detection and positioning in chaotic photos, facial feature extraction, and expression assortment. Successive to training, the model accurately differentiates emotions as angry, happy, sad, or neutral.

A lot of research is being done in the field of Computer Vision and Machine Learning (ML), which trains machines to various determine human emotions or moods. Machine learning propose a number of advances to acknowledge human emotions. One approach is to use the Mobile-Net model with Keras, which results in a tiny trained model and promotes Android-ML integration.

**METHODOLOGY**

The core of VibeCraft involves analyzing the audio features of the input song and matching them with those of a larger dataset. The following steps outline the methodology used:

1. **Song Input**: The user provides a song title and its release year.
2. **Data Retrieval**: Using the Spotify API, VibeCraft fetches detailed audio features of the song, including attributes like valence, energy, danceability, loudness, and others.
3. **Clustering and Dimensionality Reduction**: K-means clustering is applied to categorize songs based on audio characteristics. Principal Component Analysis (PCA) and t-SNE are used for dimensionality reduction to visualize the data.
4. **Recommendation Algorithm**: The system calculates the Euclidean distance between the input song and other songs in the dataset. Using cosine similarity, it identifies the closest matches and recommends five songs based on the audio features.

**Key Techniques Used:**

* **K-Means Clustering**: Group songs with similar audio characteristics into clusters.
* **PCA and t-SNE**: Reduce the dimensionality of audio features for better clustering and visualization.
* **Cosine Similarity**: Compare the input song’s feature vector with others to find the closest matches.

**HARDWARE/SOFTWARE REQUIRED**

**Software:**

* Python 3.x
* Libraries:
  + **Spotipy** for interacting with Spotify API
  + **Pandas** for data manipulation
  + **Scikit-learn** for machine learning algorithms (KMeans, PCA, t-SNE, etc.)
  + **Streamlit** for building the interactive web application
  + **Plotly** for visualizations

**Hardware:**

* A basic system with internet access for API calls to Spotify.
* Computational resources sufficient for handling the machine learning model training and prediction (e.g., a laptop or server with adequate CPU).

**EXPERIMENTAL RESULTS**

**Performance Metrics:**

* **Accuracy**: Evaluated using precision and recall based on user feedback and the quality of song recommendations.
* **User Experience**: Users tested the system with various song inputs, and results were visually assessed based on cluster alignment and recommendation relevance.
* **Visualizations**: The use of t-SNE scatter plots helps demonstrate how well songs are clustered and how close the recommendations are to the input song.

**Sample Output:**

* **Input Song**: "Bloody Sweet" (2023)
* **Recommended Songs**:
  1. "Dark Shadows" by Artist X (2023)
  2. "Sweet Summer Vibes" by Artist Y (2022)
  3. "Melancholy Beats" by Artist Z (2023)
  4. "Chill Wave" by Artist A (2023)
  5. "Vibing" by Artist B (2023)

**CONCLUSIONS**

VibeCraft successfully provides a simple yet effective music recommendation system that matches songs based on their audio characteristics. By using machine learning techniques like clustering and dimensionality reduction, the system ensures that recommended tracks are in harmony with the user's input in terms of mood, genre, and overall vibe. The tool's intuitive design allows for easy exploration of new music tailored to individual preferences.

**FUTURE SCOPE**

Future improvements for VibeCraft include:

* **Personalization**: Incorporating user listening history to refine song suggestions.
* **Scalability**: Expanding the dataset to include a larger variety of genres and songs, improving recommendation diversity.
* **Advanced Models**: Exploring deep learning models to better capture complex audio features and improve recommendation accuracy.
* **User Feedback Loop**: Allowing users to rate or provide feedback on recommendations to enhance the model over time.

**GitHub link of project:**

https://github.com/chinimoi/VibeCraft