MoodSync: AI-Powered Playlists for Emotional Resonance

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Background & Motivation
Music has long been recognized as a powerful medium for emotional expression and healing. In recent years, music therapy has gained traction as an effective intervention for a variety of emotional and psychological challenges. Research indicates that listening to music that resonates with an individual's current emotional state can provide comfort, validation, and relief. This phenomenon can be particularly beneficial for those dealing with stress, anxiety, depression, or other emotional disturbances.

The underlying principle is that music can evoke and amplify emotions, offering a means for individuals to process their feelings. For example, someone experiencing sadness may find solace in melancholic melodies, while an individual feeling anxious may benefit from calming and soothing sounds. The therapeutic potential of music lies in its ability to create a safe space for emotional exploration and healing. In this context, our project aims to develop a system that harnesses the power of music therapy by providing personalized music recommendations based on users' emotional states.

Problem Statement
Our project aims to develop a playlist recommendation tool that infers a user's mood from their text input and suggests a list of songs that fit their mood.

Scope and Objectives
The primary objectives in this project:

1. Collect and preprocess a large dataset of text labeled with associated emotions.
2. Develop a sentiment analysis model to predict the user's emotion given their input text.
3. Develop a data-driven mapping system that connects the user's predicted emotion to song metrics that can be used to filter/select song recommendations.
4. Develop a user-friendly frontend for a seamless playlist recommendation process.

Learning Emphasis
The project will focus on the training, utilization, and deployment of machine learning and large language models on emotion classification and song recommendation based on sentiment analysis with the MLOps skills learned through the course.

Data Sources

- **Emotion Detection From Text Dataset**
  https://www.kaggle.com/datasets/pashupatigupta/emotion-detection-from-text

This dataset contains 39,827 pieces of text consisting of tweets, with associated labeled emotions. There are 13 unique emotion labels in the dataset such as neutral, worry, hatred, etc. This could be useful in fine-tuning our sentiment analysis model to improve the model's ability to understand everyday semantics and modern day commonly used words and their associated emotions.

- **278k Emotion Labeled Spotify Songs:**
  https://www.kaggle.com/datasets/abdullahorzan/moodify-dataset/

This dataset consists of 278,000 songs with various audio metrics such as tempo, danceability, energy, etc., along with emotion labels (sad, happy, energetic, calm). All of the columns in this table would be helpful in our task of mapping emotions to song metrics in order to accurately recommend relevant songs to the user.

- **Spotify Million Song Dataset:**
  https://www.kaggle.com/datasets/notshrirang/spotify-million-song-dataset

This dataset contains 57,494 songs with attributes including artist, song name, link, and lyrics. The columns of interest for us in this data would be the lyrics, as we may be able to utilize it with LLM methods to provide emotion labels for each song, to help with the task of recommending relevant songs based on the user's emotion.

- **Allmusic Moods Dataset:**
  https://www.allmusic.com/moods,
  https://github.com/fdlm/listening-moods/tree/master?tab=readme-ov-file

This dataset contains 66,993 songs with artist, album and song names, with 188 emotion labels that can be scraped from the website in the first link. The second link is a Github repository that contains a model trained from this music metadata in order to predict mood, which can serve as a useful reference if we choose to utilize the Allmusic data.

Application Mock Design

Home Screen / Main Interface

- **Text Input Box:** This will be the central element on the home screen, allowing users to enter text that describes their current emotional state, thoughts, or feelings. The design

would include a large, prominent textbox to ensure ease of use. The input could be as simple as a sentence, phrase, or even a paragraph.

- **Submit Button:** Below the text input box, there will be a clear and accessible button to submit the input. Once clicked, the system will process the input and predict the user's emotional state using sentiment analysis.
- **Emotion Indicator:** After processing, a graphical or textual emotion indicator will display the detected emotion(s) based on the sentiment analysis. This could be in the form of a word, emoji, or simple icon representing the identified emotion.
- **Generated Playlist:** A section of the interface will be dedicated to displaying a list of song recommendations, along with relevant metadata such as song title, artist, and a link to listen via Spotify. Each song in the playlist will include clickable buttons for easy access to streaming.

Research and Development

We are considering multiple techniques in implementing this project, notably if the existing databases on song emotions aren't comprehensive in the complexity of emotions people experience, we might generate labels ourselves using traditional machine learning models such as CNN or pretrained large language models based on the lyrics of the song and other available features such as tempo.

Instead of building a model from scratch, we will use transfer learning techniques. This involves fine-tuning a pre-trained model on our specific dataset, which includes text labeled with associated emotions. By adjusting the model to recognize the nuances of emotional expression in our dataset, we can improve its predictive performance for the specific task of sentiment analysis.

For the task of predicting the user's emotion based on their input text, we will start by reviewing pre-trained sentiment analysis models available in the literature and open-source platforms (e.g., Hugging Face, TensorFlow Hub). Models like BERT, RoBERTa, or DistilBERT are known for their effectiveness in understanding contextual sentiment and could serve as a strong foundation. With the text-to-emotion datasets that we found, we plan to explore fine-tuning methods to improve the model's sentiment analysis performance. For the task of recommending songs based on the determined emotion, we will research available APIs (such as Spotify API: https://developer.spotify.com/documentation/web-api) that can assist with the task of matching songs with provided emotions. We will look into potential machine learning methods such as regression or classification models that we can train with labeled song data in order to have a working model to recommend relevant songs.

Fun factor
We love music and custom playlists! They are indistinguishable parts of our lives right now, serving as a source of joy and comfort.

Limitations and Risks
The proposed project faces some limitations and risks that need to be addressed for effective implementation. One major challenge is the subjectivity of emotions; individuals may respond differently to music, making it difficult to create universally effective recommendations. In addition, there is limited data available on songs with labeled emotion, especially complex emotion outside of the four basic emotions, therefore combining multiple datasets or generating new labels could be nonhomogeneous.While music can be a helpful tool for emotional support, users might become overly reliant on it as a sole coping mechanism, potentially neglecting other important forms of mental health care or support. Emotional overload may occur for some users during the exploration process, and ethical considerations arise in using music therapy without professional guidance. Addressing or even just acknowledging these factors will be crucial for developing a robust and effective system that prioritizes user well-being and satisfaction.

Milestones

Milestones	Todos	Completion by
MS2	Develop sentiment analysis model & song recommendation method pipeline -- atomic containers, versioned data pipelines, implementing and training models	10/04
	Scale models and organize pipeline -- extend workflows with tensorflow, model optimization, performance monitoring, experiment tracking, multi-GPU training and serverless training	10/18
MS3	Midterm presentation - finish and present completed CLI-based mega pipeline application	10/31
MS4	Frontend development (including API calls and design docs)	11/15
MS5	Work on medium post, and organize github repository Thanksgiving 11/26~12/01	11/25
	Work on 6-min video presentation	12/11