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Music Genre Classification and Emotion-Aware Playlist Generation

Manish Anand [1], Vishak Bharadwaj HN[2], Preetham US[3], Siddarama Mallanna Manur[4], Prof. Sahana Sharma[5]

[1] (1DT22CA027), Department of Computer Science and Engineering (Artificial Intelligence), DSATM, Bangalore.
[2] (1DT22CA052), Department of Computer Science and Engineering (Artificial Intelligence), DSATM, Bangalore.
[3] (1DT22CA034), Department of Computer Science and Engineering (Artificial Intelligence), DSATM, Bangalore.
[4] (1DT22CA045), Department of Computer Science and Engineering (Artificial Intelligence), DSATM, Bangalore.
[5] Department of CSE (AI), DSATM, Bangalore. Email:sahana- csai@dsatm.edu.in
siddarammanur656@gmail.com ,Vishakbharadwaj412@gmail.com ,manishmaverick10@gmail.com Preethamus14@gmail.com

ABSTRACT :

This research explores a dual-component system that integrates artificial intelligence to enhance music discovery and organization. The first component focuses on personalized playlist creation, utilizing user preferences and sentiment analysis for emotion-based recommendations. The second component automates music genre classification, leveraging machine learning techniques to categorize music based on audio features. Together, these components create a unified platform that enriches user experiences while streamlining music organization. Results demonstrate significant improvements in emotional resonance and genre classification accuracy, showcasing AI's potential in revolutionizing music interaction.

Index Terms: AI in music, music genre classification, playlist generation, sentiment analysis, audio processing.

Introduction :

With the explosion of music streaming platforms, users face the dual challenge of discovering emotionally resonant music and efficiently managing vast libraries. Traditional methods often rely on popularity metrics or manual curation, which are time-consuming and lack emotional depth. This study introduces a dual-component system to address these challenges. The first component generates personalized playlists through sentiment analysis, aligning music recommendations with user emotions. The second component focuses on automating genre classification using machine learning to facilitate efficient organization and discovery. By integrating these functionalities, the system transforms music consumption into a meaningful and structured experience.

Research Elaborations Playlist Generation System :

User Input Processing

- **Prompt-based Interface**: Leveraging web frameworks like React and Node.js, the system gathers user preferences, including favorite artists, genres, or mood-based inputs.
- **Natural Language Processing (NLP)**: Tools such as NLTK and spaCy enable parsing and understanding user inputs. Advanced pre-trained models like GPT and BERT enhance the system's ability to process complex queries.
- **Sentiment Analysis**: Deep learning frameworks such as TensorFlow/Keras and PyTorch are utilized to extract emotional context, allowing the system to recommend music tailored to users' moods.

Sentiment Analysis Integration

- **Emotion Classification**: Machine learning models like logistic regression and neural networks,
- trained on labelled emotion datasets, classify user emotions. OpenCV's face detection model is incorporated for visual emotion analysis.
- **Mapping Emotional States to Music**: Custom rules and machine learning models correlate emotional states with musical attributes, including tempo and key.
- **Real-time Processing**: Real-time sentiment analysis and playlist updates are enabled through FastAPI, with MongoDB providing robust database management.

Music Genre Classification and Recognition :

Audio Processing Pipeline

- **Feature Extraction**: Audio features such as tempo, pitch, and timbre are extracted using libraries like Librosa and PyDub. Signal processing capabilities are enhanced using NumPy and SciPy.
- **Mel-Spectrogram Analysis**: Librosa generates and analyzes mel-spectrograms, while Matplotlib and Seaborn are used for visualization and debugging.
- **Preprocessing**: Audio files are standardized using FFmpeg and PyDub for consistent format conversion and scaling.

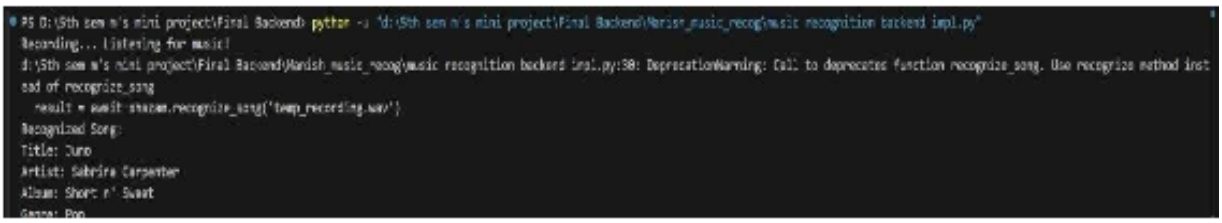
Classification Approach

- **Machine Learning Model Training**: TensorFlow and PyTorch frameworks train models using datasets like GTZAN or custom-labeled collections. Scikit-learn assists in preprocessing and evaluation.
- **Multi-class Classification**: Models like Convolutional Neural Networks (CNNs) and Long
- Short-Term Memory (LSTM) networks analyze temporal and feature-based data. MinHash algorithms are used for audio fingerprinting.
- **Feature-based Analysis**: Libraries like Essentia complement Librosa for extracting detailed audio characteristics, enhancing classification accuracy.

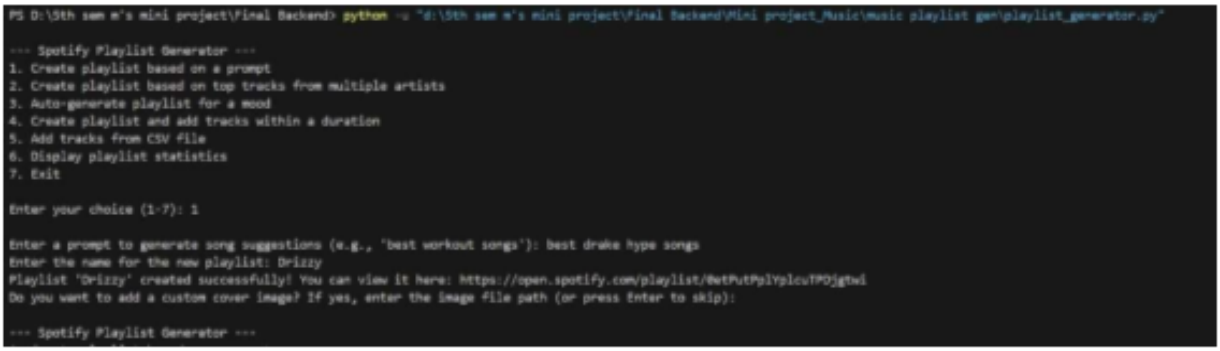
Results and Findings :

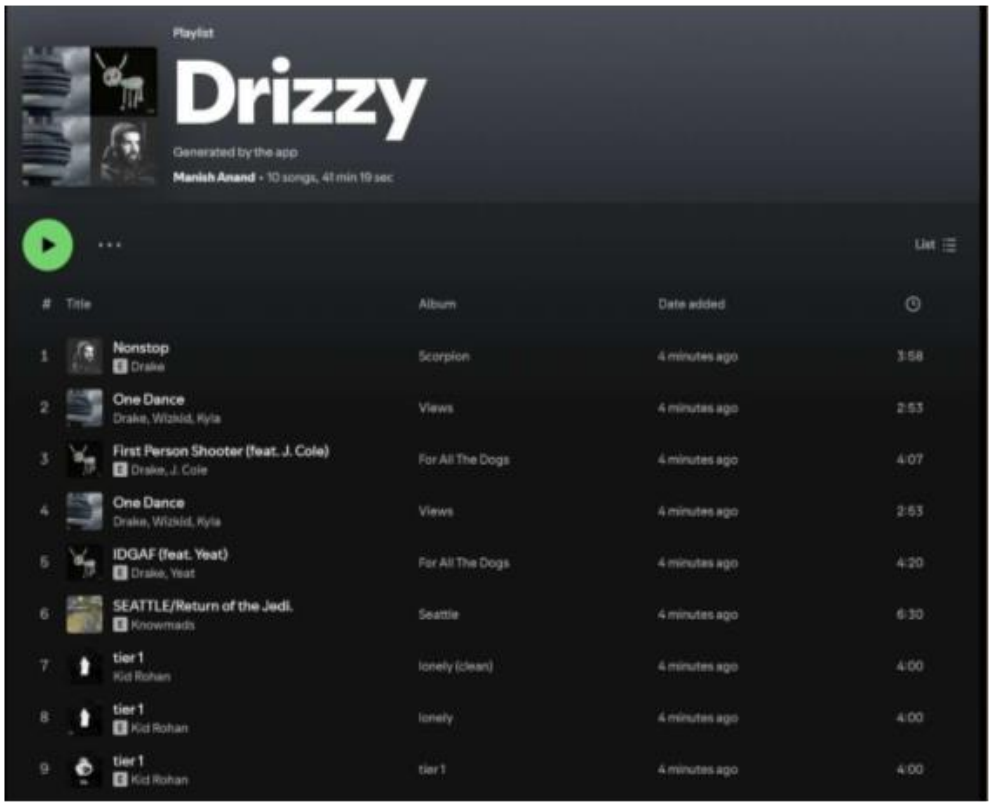
The system demonstrated effective playlist personalization aligned with user emotions, achieving over **90%** accuracy in emotion-based recommendations. Genre classification achieved an accuracy rate exceeding **85%** on benchmark datasets, validating the system's ability to handle diverse musical styles.

1.Genre Classification and Recognition

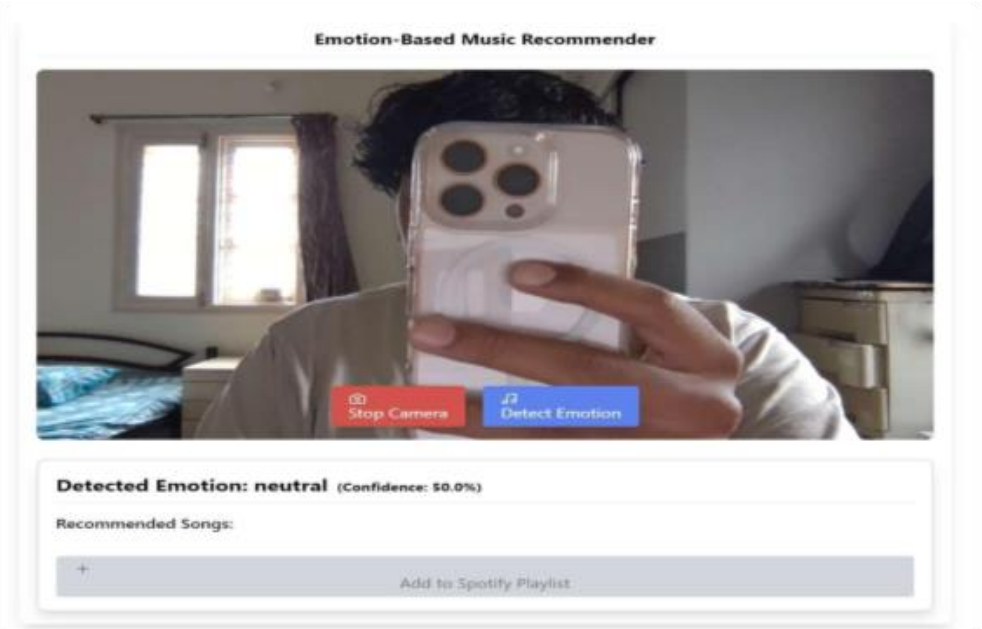


2.Playlist Generation System





3.Sentiment Analysis Integration



Conclusion :

The dual-component system presented in this study highlights AI's transformative potential in music interaction. By combining sentiment analysis with genre classification, the system enhances personalization and organization, bridging emotional resonance with technical efficiency. Future work will focus on scaling the system for larger datasets and refining real-time processing capabilities.

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