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Music Palette Analyzer: Turning Music into Colors

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Abstract: ***The Music Palette Analyzer is a web-based application that explores the relationship between music and visual color composition by analyzing album cover artwork. The system allows users to search for an artist or album and retrieves the corresponding official album artwork through the Spotify Web API. The retrieved image is processed using image processing and computer vision techniques, while K-Means clustering groups similar RGB pixels to identify dominant colors. The extracted colors are converted into hexadecimal color codes and presented as an interactive visual palette together with color percentages. The system also provides a visual mood interpretation using categories such as calm, energetic, warm, dark, and vibrant. The project combines web development, API integration, image processing, machine learning, and interactive visualization to provide an accessible way to study the visual identity of music albums.***

Keywords: Music–Color Association, K-Means Clustering, Computer Vision, Spotify Web API, Image Processing, Color Palette, Mood Analysis.

I. INTRODUCTION

The rapid growth of digital music platforms has made album artwork an important part of the visual identity of music. While music streaming services provide extensive information about songs, artists, and albums, their primary emphasis is on audio content and playback. Visual characteristics of album artwork are generally presented as static images, with limited computational analysis of their color composition. Music Palette Analyzer is proposed as an interactive web application that connects music discovery with visual color analysis. The system enables a user to enter an artist or album name, retrieve the corresponding album cover using the Spotify Web API, and process the artwork to determine its dominant colors. K-Means clustering is used as an unsupervised learning technique to group similar pixel colors and obtain representative color clusters. The extracted colors are converted into HEX values and displayed as an interactive palette. Color percentages are also presented to indicate the relative contribution of dominant colors within the artwork. In addition, the system provides a visual mood interpretation based on the identified colors.

II. LITERATURE SURVEY

Research on music and color has shown that people can form consistent associations between auditory characteristics, emotion, and visual colors. Palmer et al. [1] investigated music–color associations and reported strong relationships between emotional responses to music and selected colors.

Lindborg and Friberg [2] studied color associations with music using a CIE Lab color interface, audio features, emotion ratings, and statistical modeling. Whiteford et al. [3] further examined music, color, and emotion across musical excerpts and found that emotional content strongly influenced music–color associations.

Barbiere et al. [4] explored correspondence between music and color through emotion classification and color selection. Ilea and Whelan [5] investigated spatial K-Means clustering for color image segmentation, demonstrating the usefulness of clustering methods for grouping visually similar pixels.

The proposed system combines music-platform artwork retrieval, image processing, K-Means color extraction, and interactive visualization within a single web application.

III. PROBLEM STATEMENT

Music streaming platforms provide access to millions of songs and albums, but they generally do not computationally analyze the visual characteristics of album artwork. Users can view cover images, yet they are not normally provided with information about dominant colors, their relative proportions, or a visual interpretation of the artwork's color mood.

The absence of automated color analysis limits opportunities for users, designers, artists, and researchers to explore the visual identity of music collections. Therefore, there is a need for an interactive system that can automatically retrieve album artwork, analyze its pixel-level color composition, extract representative colors, and present the results in an understandable form.

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IV. PROPOSED METHODOLOGY

The proposed system follows a sequential workflow consisting of album search, artwork retrieval, image preprocessing, dominant-color extraction, color representation, and mood interpretation. The frontend communicates with a Python-based backend and external music services.

First, the user enters an artist or album name through the application interface. The backend communicates with the Spotify Web API to search for the requested item and retrieve the associated album artwork. The selected image is then passed to the image-processing pipeline.

During image processing, the artwork is handled using OpenCV, Pillow, and NumPy. Pixel information is represented in RGB space and prepared for clustering. K-Means clustering groups pixels with similar color characteristics into a predefined number of clusters. The cluster centers act as representative dominant colors.

The RGB cluster centers are converted into hexadecimal color codes. The contribution of each cluster is used to calculate the percentage representation of the corresponding color. A rule-based visual interpretation maps dominant color characteristics to descriptive mood categories such as calm, energetic, warm, dark, and vibrant.

V. IMPLEMENTATION

The Music Palette Analyzer is implemented as a web application using a frontend, backend, API integration layer, and image-analysis pipeline. The frontend is developed using Next.js, React, Tailwind CSS, and Framer Motion to provide an interactive and responsive user interface.

The backend is implemented using FastAPI and Python. It handles requests from the frontend, communicates with the Spotify Web API, and coordinates the image-analysis operations. Spotify Web API integration is used to search for artists or albums and obtain album artwork.

For image processing, OpenCV, Pillow, and NumPy are used to load artwork, process image data, and access RGB pixel values. K-Means clustering is then applied to group similar pixels and identify representative dominant colors. The resulting RGB values are converted to HEX codes and combined with color percentages for visualization.

The mood-analysis component interprets the extracted dominant colors using predefined visual categories. The output is presented as an interactive palette so that users can observe both the visual composition of the artwork and its associated mood description.

VI. OUTPUT

The system output consists of the retrieved album artwork, the dominant color palette, HEX color codes, color percentages, and a visual mood description. The output is designed to make the color composition of album artwork easy to understand through an interactive visual representation.

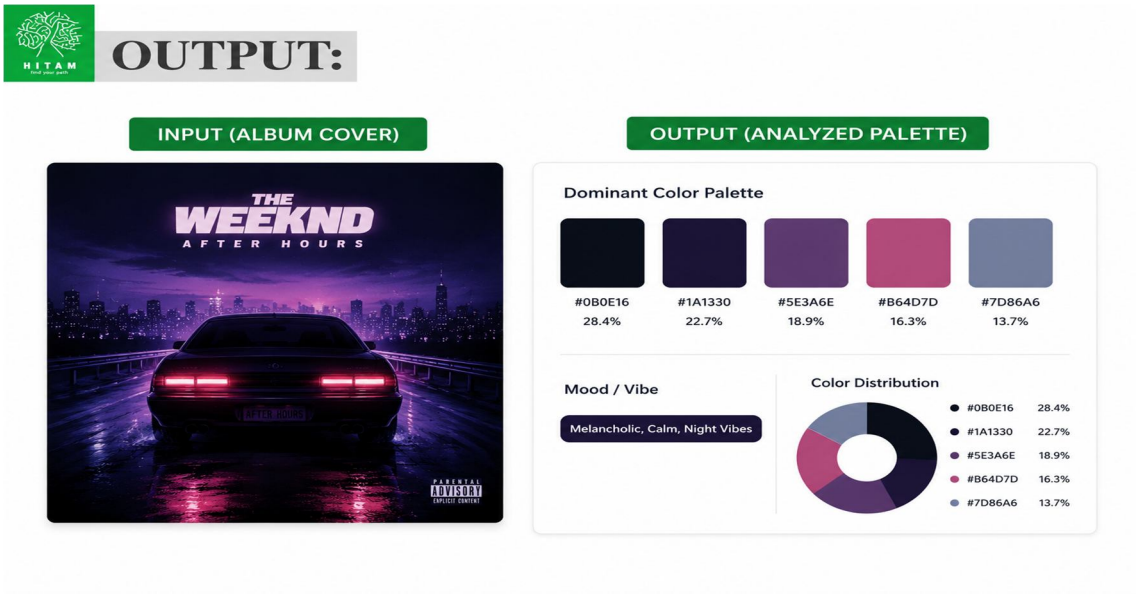


FIG. 01: SAMPLE OUTPUT OF THE MUSIC PALETTE ANALYZER

VII. RESULTS

The developed prototype demonstrates the complete workflow of the Music Palette Analyzer. A user can search for an artist or album, retrieve the corresponding album artwork, and pass the artwork through the color-analysis pipeline. The system identifies representative dominant colors using K-Means clustering and displays the resulting palette.

The output includes hexadecimal color codes and color percentages, enabling users to understand the major visual components of an album cover. The mood interpretation provides an additional descriptive layer by associating the dominant palette with visual categories such as calm, energetic, warm, dark, or vibrant.

The implementation demonstrates the integration of web development, Spotify API integration, Python-based image processing, and unsupervised machine learning for color clustering. The current project documentation does not report a numerical accuracy study, benchmark dataset, or formal user evaluation; therefore, the results are presented as functional and qualitative outcomes of the implemented prototype.

VIII. FUTURE SCOPE

The Music Palette Analyzer can be extended to support comparison of color palettes across multiple albums and artists. Genre-based analysis could be introduced to investigate visual color patterns across different music genres.

Future versions can incorporate Spotify audio features such as energy, valence, tempo, and danceability to connect visual color information with measurable properties of the associated music. The system can also be extended to identify albums with visually similar palettes, generate music-reactive animations, allow users to download or share generated palettes, and store previously analyzed albums.

IX. CONCLUSION

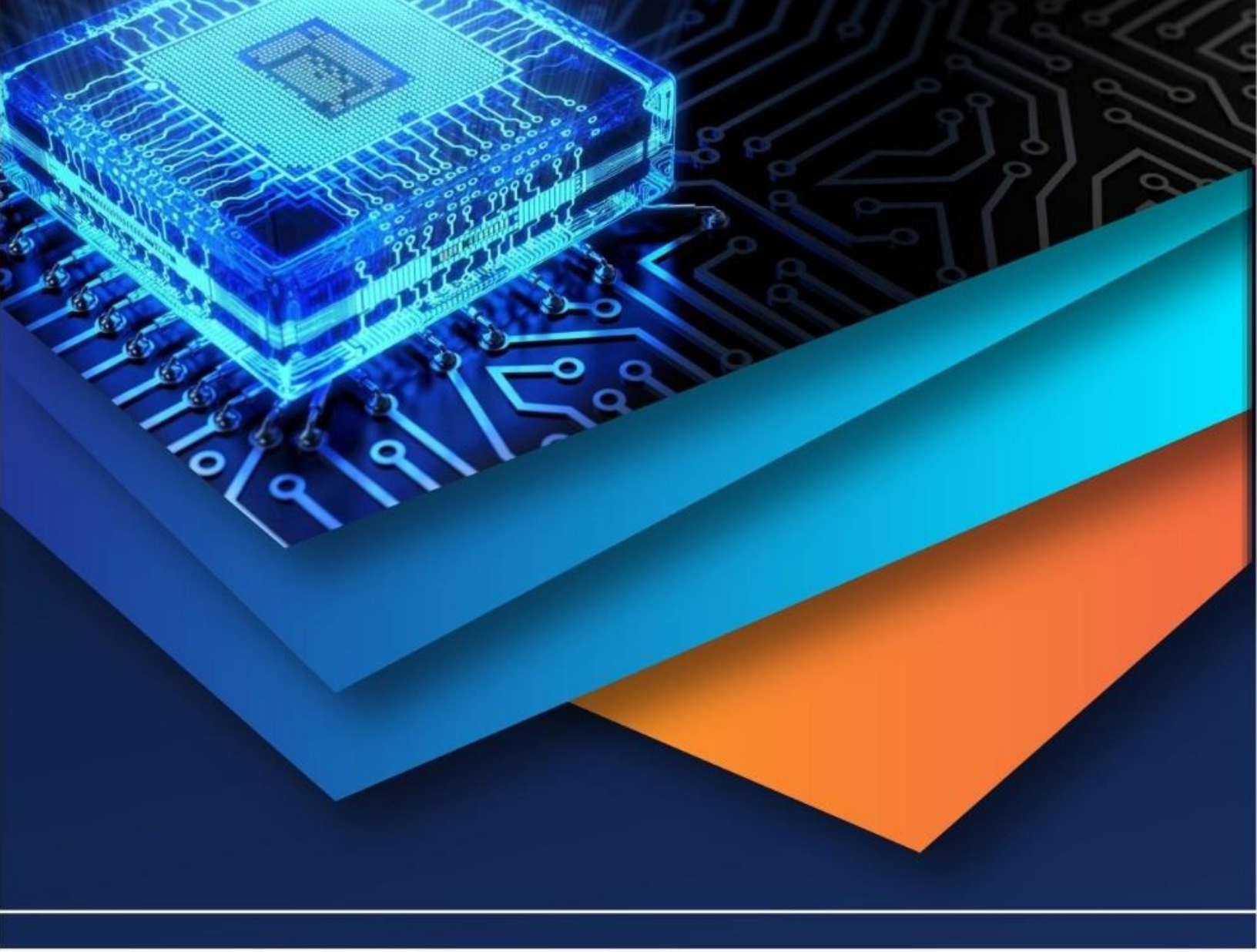
Music Palette Analyzer provides an automated approach for analyzing the visual color composition of music album artwork. The system combines Spotify Web API integration, image processing, K-Means clustering, and interactive web visualization to extract and present dominant colors from album covers.

By converting clustered RGB values into HEX color codes and color percentages, the system makes the visual characteristics of album artwork easier to explore. The project demonstrates a practical integration of machine learning, computer vision, API-based data retrieval, and modern web development, while providing a foundation for future multimodal music and visual analysis.

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