

Software Requirement Specification

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Project ID & Name	Audio Processing		
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Customer Request Reference			
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1 Requirement Scope Summary

This project entails developing a Python-based application for basic audio processing. The application will load an audio file, perform various signal processing operations, extract key audio features, and save these features to a CSV file. Additionally, it will generate and save visualizations of the audio signal, including its waveform and spectrogram.

2 Functional Requirements Identification

2.1 Audio File Loading

- **Description:** The system must be able to load an audio file using an audio processing library.
- **Priority:** High

2.2 Audio Signal Processing and Visualization

- **Description:** The system must perform the following operations on the audio signal.
 - Plot the waveform of the audio signal.
 - Compute and display the spectrogram.
 - Extract and visualize specific audio features.
- **Priority:** High

2.3 Feature Extraction

- **Description:** The system must extract the following features from the audio signal.
 - MFCC (Mel-Frequency Cepstral Coefficients)
 - Chroma features
 - Spectral contrast
 - Zero-crossing rate
 - Spectral roll-off
- **Priority:** High

2.4 Data Storage

- **Description:** The system must save all extracted features to a CSV file.
- **Priority:** High

2.5 Deliverables

- **Description:** The project deliverables include:
 - A Python script with a main section that processes an audio file using the specified functions.
 - Visualizations (plots) saved as images in a directory named `audio_plots`.
 - Extracted features saved in a CSV file named `audio_features.csv`.
- **Priority:** High

3 Functional Requirements Details

3.1 Functional Requirement 1: Audio File Loading

Details

- **Input:** An audio file (e.g., .wav, .mp3).
- **Process:** Use an audio processing library such as `librosa` or `pydub` to load the audio file.
- **Output:** An audio signal array for further processing.

3.2 Functional Requirement 2: Audio Signal Processing and Visualization

Details

- **Input:** Loaded audio signal array.
- **Process:** Perform the following visualizations:
 - **Waveform:** Plot the waveform of the audio signal.
 - **Spectrogram:** Compute and display the spectrogram of the audio signal.
- **Output:** Displayed plots and saved images in the `audio_plots` directory.

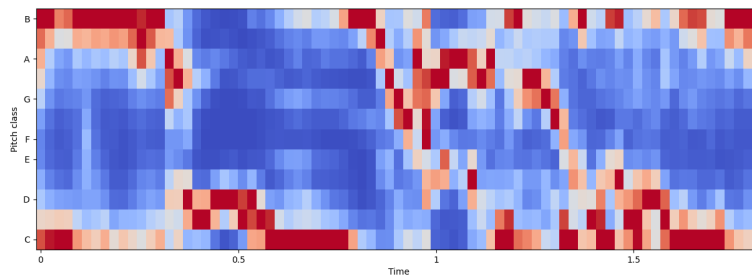


Figure 1: Chroma plot

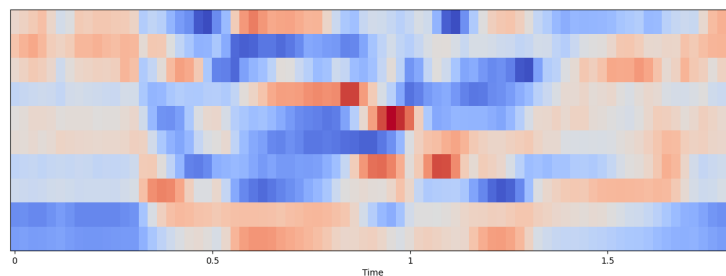


Figure 2: MFCC plot

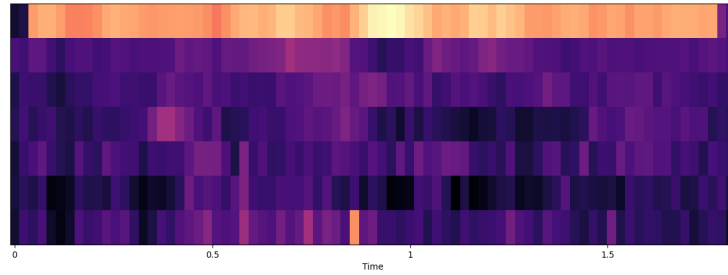


Figure 3: Spectral Contrast

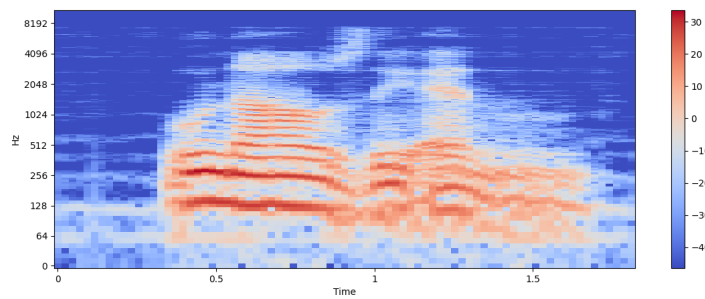


Figure 4: Waveform Spectrum

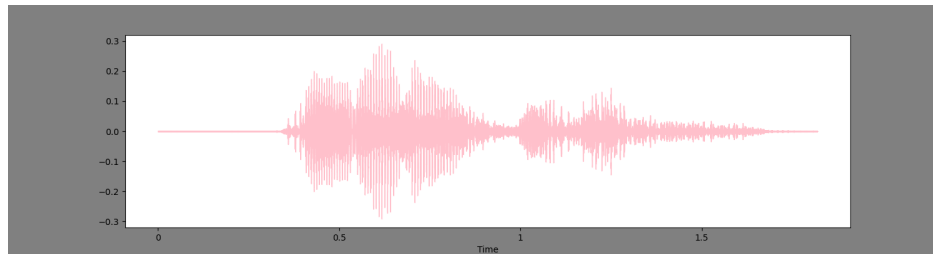


Figure 5: Waveform

3.3 Functional Requirement 3: Feature Extraction

Details

- **Input:** Loaded audio signal array.
- **Process:** Extract the following features:
 - **MFCC:** Extract Mel-Frequency Cepstral Coefficients.
 - **Chroma Features:** Extract chroma features.
 - **Spectral Contrast:** Extract spectral contrast.
 - **Zero-Crossing Rate:** Compute the zero-crossing rate.
 - **Spectral Roll-Off:** Compute the spectral roll-off.
- **Output:** Extracted features.

3.4 Functional Requirement 4: Data Storage

Details

- **Input:** Extracted features.
- **Process:** Save the extracted features to a CSV file named `audio_features.csv`.
- **Output:** A CSV file containing the extracted features.

3.5 Functional Requirement 5: Deliverables

Details

- **Input:** Python script, plots, and extracted features.
- **Process:** Ensure the script processes an audio file, displays plots, and saves features.
- **Output:**
 - Python script.
 - Plots saved in `audio_plots` directory.
 - Extracted features saved in `audio_features.csv`.