Features Directory Documentation

Detailed Explanation of Feature Files

1. Feature Matrix Files

X.joblib and y.joblib

Purpose: Primary feature matrix and label storage **Format**: Joblib compressed files **Size**: X.joblib (225KB), y.joblib (11KB) **Contents**:

- `X.joblib`: Contains the feature matrix with shape (n_samples, n_features)
  - Each row represents one audio sample
  - Features include MFCC, spectral, and statistical features
  - Preprocessed and normalized values
- `y.joblib`: Contains the corresponding emotion labels
  - One label per audio sample
  - Encoded emotion categories
  - Used for model training and evaluation

X_over.joblib and y_over.joblib

Purpose: Balanced dataset for handling class imbalance **Format**: Joblib compressed files **Size**: X_over.joblib (240KB), y_over.joblib (12KB) **Contents**:

- `X_over.joblib`: Oversampled feature matrix
  - Contains additional samples for minority classes
  - Generated using RandomOverSampler
  - Maintains feature distribution
- `y_over.joblib`: Balanced emotion labels
  - Equal number of samples per emotion class
  - Used for training models on balanced data
  - Helps prevent model bias

2. Feature DataFrames

df_features.csv

Purpose: Comprehensive feature storage **Format**: CSV file **Size**: 63KB **Contents**:

- Extracted audio features for each sample
- Columns include:
  - MFCC coefficients
  - Spectral features
  - Statistical measures
  - Temporal features
- Used for feature analysis and visualization
- Contains 1442 rows (samples)

df_spectrogram.csv

Purpose: Spectrogram feature storage **Format**: CSV file **Size**: 6.8MB **Contents**:

- Mel spectrogram features
- Time-frequency representation
- Contains:
  - Frequency bins
  - Time frames
  - Energy values
- Used for CNN model input
- Large size due to detailed spectrogram data

df_chroma.csv

Purpose: Chroma feature storage **Format**: CSV file **Size**: 6.8MB **Contents**:

- Chroma features for each audio sample
- Represents pitch class profiles
- Contains:
  - 12 chroma coefficients
  - Temporal information
  - Harmonic content
- Used for pitch-based emotion analysis
- Large size due to detailed chroma data

df_paths.csv

Purpose: Audio file path reference **Format**: CSV file **Size**: 115KB **Contents**:

- File paths to original audio samples
- Contains 1442 rows

- Used for:
    - Data organization
    - Sample tracking
    - Feature-to-audio mapping
- Essential for data management and reproducibility

3. Model Evaluation Reports

mlp_clas_report.csv

Purpose: MLP model performance metrics **Format**: CSV file **Size**: 738B **Contents**:

- Classification metrics for MLP model:
    - Precision
    - Recall
    - F1-score
    - Support
- Per-class performance
- Overall model evaluation
- Used for model comparison

cnn_clas_report.csv

Purpose: CNN model performance metrics **Format**: CSV file **Size**: 738B **Contents**:

- Classification metrics for CNN model:
    - Precision
    - Recall
    - F1-score
    - Support
- Per-class performance
- Overall model evaluation
- Used for model comparison

File Relationships and Usage

Data Flow

1. Audio files → Feature extraction → df_features.csv
2. df_features.csv → Feature processing → X.joblib, y.joblib
3. X.joblib, y.joblib → Balancing → X_over.joblib, y_over.joblib
4. Audio files → Spectrogram/Chroma extraction → df_spectrogram.csv, df_chroma.csv
5. Model training → Performance evaluation → mlp_clas_report.csv, cnn_clas_report.csv

Usage in Pipeline

1. **Feature Extraction**:
    - Uses df_paths.csv to locate audio files
    - Generates df_features.csv, df_spectrogram.csv, df_chroma.csv
2. **Data Preprocessing**:
    - Converts CSV data to joblib format
    - Creates X.joblib and y.joblib
    - Applies balancing to create X_over.joblib and y_over.joblib
3. **Model Training**:
    - Uses balanced data (X_over.joblib, y_over.joblib)
    - Trains both MLP and CNN models
    - Generates classification reports
4. **Evaluation**:
    - Compares model performance using classification reports
    - Helps in model selection and optimization

Technical Details

File Formats

- **Joblib Files**: Python-specific serialization format
    - Efficient for numerical data
    - Preserves Python objects
    - Faster than CSV for large datasets
- **CSV Files**: Standard text format
    - Human-readable
    - Compatible with various tools
    - Easy to inspect and modify

Data Organization

- Hierarchical structure
- Clear separation of concerns
- Efficient storage and retrieval
- Easy to maintain and update

Performance Considerations

- Large spectrogram and chroma files (6.8MB each)
- Efficient joblib compression for feature matrices
- CSV format for human-readable reports
- Balanced storage of different data types

Maintenance and Updates

Regular Tasks

1. Monitor file sizes
2. Update feature extraction if needed
3. Regenerate reports after model updates
4. Maintain data consistency

Best Practices

1. Keep original data backed up
2. Document any changes
3. Version control for important files
4. Regular cleanup of temporary files

This documentation provides a comprehensive overview of the features directory contents and their roles in the Speech Emotion Recognition System.