Task Distribution and Guidelines for FSDD DSP Project

Project Overview

This document distributes the tasks of the Free-Spoken Digit Dataset (FSDD) DSP project among four students. Each student is responsible for a specific part of the project, with clear tasks and guidelines to follow.

Team Members and Responsibilities

Student 1: Dataset Handling & Time-Domain Analysis

Primary Tasks:

- Download and explore the FSDD dataset from: `https://github.com/Jakobovski/free-spoken-digit-dataset`

- Perform Exploratory Data Analysis (EDA)

- Visualize waveforms and time-domain properties

- Implement time-domain feature extraction:
    - Zero-Crossing Rate
    - RMS Energy
    - Temporal Envelope
    - Autocorrelation Coefficients

- Apply basic filtering techniques

- Document challenges (speaker variability, temporal patterns)

Tools: Python (librosa, numpy, matplotlib)

Student 2: Frequency-Domain Analysis

Primary Tasks:

- Implement Short-Time Fourier Transform (STFT)

- Apply windowing, zero-padding

- Extract frequency-domain features:

  - Spectral Centroid
  - Bandwidth
  - Formant Analysis
  - MFCC

- Visualize spectrograms

- Discuss window size trade-offs and DFT challenges

Tools: Python (librosa, scipy, matplotlib)

Student 3: Wavelet Transform Analysis

Primary Tasks:

- Study wavelet theory relevant to speech signals

- Implement Discrete Wavelet Transform (DWT) using pywavelets

- Extract wavelet features:

  - Energy per decomposition level
  - Wavelet Entropy
  - Statistical analysis of coefficients

- Compare time-frequency resolution with STFT

- Visualize scalograms

Tools: Python (pywavelets, matplotlib)

Student 4: Classification System & Final Report

Primary Tasks:

- Design and implement the classification system using extracted features

- Use scikit-learn for training and evaluation

- Evaluate classifiers using:

  - Accuracy
  - Confusion Matrix
  - Comparative Analysis

- Discuss:

  - Effectiveness of feature types
  - Which digits were harder/easier

- Trade-offs and findings

- Prepare the presentation slides

- Compile final report and GitHub repository

Tools: Python (scikit-learn, matplotlib), GitHub, LaTeX

General Guidelines for All Members

- Follow timeline strictly.

- Write clean, well-commented code.

- Visualize everything possible.

- Document challenges, ideas, and results.

- Push all code and results regularly to GitHub.

- Communicate frequently with teammates.