COPD-FusionNet Dashboard Tutorial

This tutorial guides you through setting up and using the COPD-FusionNet Dashboard, an interactive tool for Chronic Obstructive Pulmonary Disease (COPD) detection using multimodal AI.

1. Introduction

The **COPD-FusionNet Dashboard** is a user-friendly, web-based interface designed to demonstrate the capabilities of our multimodal deep learning model. It allows clinicians and researchers to:

- **Upload Audio Recordings:** Analyze respiratory sounds (e.g., coughs, breathing) for acoustic biomarkers of COPD.
- **Input Patient Metadata:** Enter demographic information (Age, Sex) and observed symptoms.
- **Run Real-Time Diagnosis:** Utilize our pre-trained AI models (FusionNet, EfficientNet-B2, CRNN, etc.) to predict the probability of COPD.
- **Visualize Results:** View Mel-spectrograms of the audio input and interpret the model's confidence score through an intuitive risk meter.

This tool bridges the gap between complex AI research and practical clinical application, providing an accessible way to validate our proposed **FusionNet** architecture.

2. System Requirements

Before running the dashboard, ensure your system meets the following requirements:

- **Operating System:** Windows 10/11, macOS, or Linux.
- **Python:** Version 3.8 or higher.
- **Memory (RAM):** Minimum 8 GB recommended (16 GB preferred for smoother performance).
- **Storage:** At least 2 GB of free space for datasets and model weights.
- **GPU (Optional):** NVIDIA GPU with CUDA support is recommended for faster inference, but the dashboard is optimized to run on CPU as well.

3. Installation & Setup

Follow these steps to download the code and set up your environment.

Step 1: Download the Code

1. Visit our GitHub repository: https://github.com/emrancub/COPD-FusionNet
2. Click on the green **Code** button and select **Download ZIP**.
3. Extract the ZIP file to a folder on your computer (e.g., D:\COPD-FusionNet).

Step 2: Install Dependencies

1. Open your terminal (Command Prompt or PowerShell on Windows).
2. Navigate to the project folder: ***cd D:\COPD-FusionNet***
3. Create a virtual environment (recommended to avoid conflicts): ***python -m venv venv***
4. Activate the environment:
    - **Windows:** venv\Scripts\activate
    - **Mac/Linux:** source venv/bin/activate
5. Install the required Python libraries: ***pip install -r requirements.txt***

(Note: If a requirements.txt file is not worked, manually install the key libraries: pip install torch torchvision torchaudio streamlit pandas numpy matplotlib seaborn scikit-learn)

4. How to Launch the Dashboard

1. Ensure your virtual environment is activated.
2. Run the following command in your terminal: ***streamlit run dashboard.py***
3. Wait for a few seconds. The dashboard will automatically open in your default web browser at ***http://localhost:8501***.

If it doesn't open automatically, copy the "Local URL" shown in the terminal and paste it into your browser.

5. Using the Dashboard: A Step-by-Step Guide

The dashboard interface is divided into three main sections: **Configuration**, **Data Input**, and **Analysis**.

A. Configuration (Sidebar)

On the left sidebar, you will find the **System Configuration** panel.

1. **Select AI Model:** Choose the model architecture you want to test.
    - **COPD-FusionNet (Recommended):** Our proposed multimodal model that uses both audio and patient data. It typically offers the highest accuracy.

- **Audio_EffNet / Audio_CRNN:** Unimodal audio models. Use these if you only have sound files.
- **Tab_MLP / Tab_Trans:** Unimodal tabular models. Use these if you only have patient metadata.

B. Data Input (Main Screen)

The main screen is split into two columns:

1. Respiratory Audio Input (Left Column)

- Click the **"Browse files"** button or drag and drop a .wav file into the upload area.
- The tool supports standard WAV files typically recorded from digital stethoscopes or smartphones.
- Once uploaded, you will see a **Mel Spectrogram** preview. This visual heatmap represents the frequency content of the sound over time, which the AI uses for diagnosis.

2. Patient Metadata Input (Right Column)

- **Patient Age:** Enter the patient's age (e.g., 65).
- **Sex:** Select "Male" or "Female".
- **Observed Symptoms:** Click the dropdown menu to select all relevant symptoms (e.g., "Cough", "Shortness of Breath", "Wheezing").

Note: For the FusionNet model, both Audio and Metadata inputs are required for the most accurate prediction.

C. Running the Analysis

1. Once you have provided the necessary inputs, scroll down to the **Diagnostic Analysis** section.
2. Click the large red button labeled **"RUN DIAGNOSTIC MODEL"**.
3. The system will process the inputs and run them through the neural network. This usually takes 1-2 seconds.

6. Interpreting the Results

The results will appear at the bottom of the dashboard in two sections:

1. Prediction Result

- **Diagnosis:** The model will display either **"COPD DETECTED"** (in red) or **"HEALTHY/OTHERS"** (in green).

- **Confidence Score:** A percentage value (e.g., 98.5%) indicating how certain the model is about its prediction. Higher scores indicate greater certainty.

2. Risk Meter

- A visual gauge showing where the patient's risk score falls on a scale from 0 (Healthy/Others) to 1 (COPD).
- The **black vertical line** marks the exact probability calculated by the AI.
- If the line is in the **Red zone**, it indicates a high probability of COPD. If it is in the **Green zone**, the result is likely healthy/others.

7. Troubleshooting Common Issues

- **"OMP: Error #15" Crash:**
    - This is a known issue on Windows with Intel processors. Our dashboard.py includes a fix (os.environ["KMP_DUPLICATE_LIB_OK"] = "TRUE"). If you still see this, ensure you are running the latest version of the code.
- **"Missing Audio Input" Error:**
    - You selected COPD-FusionNet or an Audio model but didn't upload a .wav file. Please upload a file to proceed.
- **Slow Performance:**
    - The first run might be slightly slower as the model weights are loaded into memory. Subsequent runs will be instant.

8. Citation

If you use this dashboard or code in your research, please cite our paper:

(We will make all necessary updates once the paper has been accepted. If you need any assistance, please contact mdemranhasan@njust.edu.cn)