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# Coughsense: Deep Learning based Audio-Driven Tuberculosis Detection using Spectrogram

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## Abstract

Tuberculosis (TB) continues to challenge global health, particularly in areas where conventional diagnostic methods are costly, invasive, and slow. Leveraging the acoustic properties of patient coughs, audio-based diagnostics offer a non-invasive and scalable alternative. In this approach, raw cough recordings undergo a multi-stage preprocessing pipeline, including noise filtering, amplitude normalization, clipping, and padding, to produce standardized and clean audio signals. These signals are then transformed into spectrograms through Fast Fourier Transform, frequency sampling, windowing, Mel-scale conversion, and logarithmic scaling, effectively converting temporal sound patterns into visual representations suitable for image-based analysis. Feature extraction employs Custom Histogram of Oriented Gradients (CHOG) to capture localized spectral characteristics, and Principal Component Analysis (PCA) reduces dimensionality while retaining discriminative information. Classification is performed using YOLO V10, which detects and differentiates TB-specific acoustic patterns from non-TB signals within the spectrograms. This integrated pipeline demonstrates a precise, low-cost, and non-invasive method for TB detection, offering rapid, real-time analysis suitable for deployment in resource-limited healthcare environments. By combining audio signal processing with advanced machine learning techniques, the methodology provides a robust framework for accessible and efficient tuberculosis screening.

**Keywords:** *Tuberculosis Detection, Cough Analysis, Spectrograms, Chog, PCA, YOLO V10, Audio Classification, Non-Invasive Diagnostics, Healthcare AI.*