Hybrid Deep Learning for Lung Sound Classification in Respiratory Disease Detection

125156040 - Harsh
125003388 - Vedant Agnihotri

Respiratory diseases, such as COPD, pneumonia, and URTI, significantly impact global health and require efficient diagnostic methods for early detection and management. This project introduces an advanced deep edge intelligence system for real-time respiratory disease detection, leveraging deep learning models for automated lung sound classification.

A key novelty of this work lies in the integration of CNN-Gated Recurrent Unit (CNN-GRU) and VGGish architectures to enhance feature representation and capture deeper temporal dependencies in lung sounds. By combining these architectures with Convolutional Neural Networks (CNN) for feature extraction from short-time Fourier transform (STFT) spectrograms, the model improves the classification of four lung sound types—normal, crackles, wheezes, and both crackles and wheezes. Additionally, the study employs the focal loss (FL) function to address training data imbalance, ensuring a more effective learning process. The proposed model is trained and validated using the ICBHI 2017 Respiratory Sound Database under three different data splitting strategies to ensure robustness and generalization.

This project aims to develop a portable and efficient diagnostic tool suitable for edge computing environments, ensuring accessibility for real-world healthcare applications. It integrates feature extraction techniques, including CNN, CNN-GRU, and VGGish, for robust classification while leveraging data augmentation and optimization strategies to enhance system performance. Future directions include real-world deployment and further refinement to bridge the gap between advanced medical diagnostics and practical healthcare solutions, particularly for resource-limited settings.

References:

1. “Automated Lung Sound Classification Using a Hybrid CNN-LSTM Network and Focal Loss Function” - https://www.mdpi.com/1424-8220/22/3/1232

Guide: 

Dr. Vidivelli S