Convolutional Neural Networks on Stethoscope Audios: COPD Diagnosis and Clinical Feature Identification

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Chronic obstructive pulmonary disease (COPD) is a chronic inflammatory lung disease that obstructs airflow and causes difficulty breathing. It is responsible for approximately 3.2 million deaths every year, making it the third leading cause of death worldwide. The World Health Organization has identified COPD as a major global health issue that remains unmet. Despite this, current diagnostic methods for COPD rely on questionnaires about a patient's symptoms, which are highly inaccurate. It is estimated that 60% of patients with COPD are misdiagnosed, and 80% remain undiagnosed. This study proposes a new diagnostic method for COPD that uses a convolutional neural network (CNN) model to analyze respiratory audios obtained from low-cost stethoscopes. By detecting specific breathing patterns in respiratory cycles, our model can accurately diagnose COPD, outperforming current diagnostic methods by 30.6%. Furthermore, we use Gradient-weighted Class Activation Mapping (GradCAMs) to identify critical clinical features necessary for diagnosis. This allows us to explain the decision-making process behind our model and helps ensure that our model is interpretable, which is critical for integration into clinical settings. Our proposed method for COPD detection shows significant promise in improving patient outcomes. Not only can our model reduce the misdiagnosis of patients, but it can also aid in early diagnosis, which is crucial for slowing the progression of COPD and potentially halting or reversing the disease's development.