01.04 - M-Health/e-health

46223
Machine learning implementation for enhanced respiratory sound classification: Assessing algorithmic efficacy

Diagnosis, Telemedicine, Monitoring

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Background: Previous research explored artificial intelligence algorithms to improve respiratory disease identification, reducing observer subjectivity and variability in traditional auscultation.
Objective: Evaluate the effectiveness of machine learning algorithms in classifying pathological respiratory sounds, including medical diagnoses (COPD, Upper Respiratory Tract Infection, Pneumonia, Bronchiectasis, Asthma, Bronchiolitis or Healthy), sex, and age group.
Methods: The International Conference on Biomedical and Health Informatics (ICBHI) database was utilized, comprising 920 respiratory sound recordings from 126 subjects. Mel-frequency Cepstral Coefficients (MFCC) and Wavelet techniques were applied for analysis. Various machine learning models, such as Support Vector Machine (SVM), K-Nearest Neighbor (KNN), Logistic Regression (LR), and Decision Tree (DT), were implemented. Internal evaluation metrics included Accuracy, Cross-Validation Accuracy, Average Precision, Average Recall, Average F1 Score, Cohen's Kappa, and area under the Receiver Operating Characteristic Curve.
Results: KNN achieved 99% accuracy in diagnoses, and LR attained 99% precision in sex detection. Cross-validation confirmed robustness with <5% standard deviation. Other combinations, such as age group, wheezes, and crackles, also scored 98%-99%.
Conclusions: The algorithms demonstrated high reliability in classifying pathological sounds, diagnoses, sex, and age group. External validation via cross-validation ensured result independence. Models best fitting external data were selected with an average precision standard deviation of 0.012, notably 0.006 for diagnosis.