

Lighting Model using CNN and LSTM for Automated Lung Disease Detection through Cough Sound

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Abstract

In recent years, cough sounds have garnered widespread attention as a potential diagnostic tool for identifying various lung diseases. In this study, we propose an innovative approach that utilizes mel frequency cepstral coefficients (MFCC) and their first and second-order differentials (Δ^2) for feature extraction to accurately distinguish between four types of cough sounds: asthma, healthy, covid-19, and heart failure. Our method leverages these advanced feature extraction techniques to capture critical characteristics and details within the cough sounds.

To achieve this goal, we integrate two-dimensional convolutional neural networks (2D-CNN) and long short-term memory (LSTM) and to effectively capture the temporal dependencies of the audio signals. Additionally, we use data augmentation algorithms to enhance the diversity and quantity of the audio data, thereby improving the model's generalization capability and classification performance. Ultimately, our system achieved an impressive 99% unweighted average recall (UAR) and 99% accuracy.

Beyond performance enhancement, we introduced adaptivfloat quantization to significantly reduce the model size while maintaining high classification accuracy. This quantization technique reduced the model size by 66.82% and increased the computational speed by approximately 7 times, which is particularly important for resource-constrained environments, enabling practical applications on portable devices. Experimental results demonstrate that even after quantization, our 2D-CNN-LSTM method can accurately classify various cough sounds, highlighting the system's substantial potential for early diagnosis and remote patient monitoring. This system offers a non-invasive and efficient means of identifying lung disease conditions through audio data, enabling early detection and real-time monitoring of patients, thus presenting significant application prospects in the medical field.

Keywords

Convolutional Neural Network, Cough signals recognition, Long Short Term Memory, Lung disease, Quantization, Mel-Frequency Cepstral Coefficients.