ABSTRAK

Disartria merupakan gangguan motorik bicara akibat kerusakan sistem saraf yang menyebabkan penurunan kejelasan artikulasi dan kesulitan komunikasi. Pengembangan sistem klasifikasi ucapan otomatis untuk penderita disartria masih menjadi tantangan karena karakteristik sinyal ucapan yang tidak stabil, variasi energi yang tinggi, serta kemiripan fonetik antar kata. Oleh karena itu, diperlukan metode ekstraksi fitur yang mampu merepresentasikan karakteristik akustik ucapan secara lebih adaptif dan sesuai dengan persepsi pendengaran manusia.

Penelitian ini bertujuan mengembangkan sistem klasifikasi ucapan disartria berbasis kata menggunakan model *Lightweight Convolutional Neural Network* (LCNN) dengan representasi fitur *Mel-Spectrogram* dan *Per-Channel Energy Normalization* (PCEN). Dataset yang digunakan berasal dari *EasyCall Corpus* yang terdiri atas lima kelas kata, yaitu *no, stop, uno, zero*, dan *invalid*, dengan total 2.972 sampel audio. Data dibagi menggunakan metode *stratified split* dengan rasio 80:10:10 untuk data latih, validasi, dan uji. Tahapan penelitian meliputi pra-pemrosesan audio, augmentasi data, ekstraksi fitur *Mel-Spectrogram*, normalisasi menggunakan PCEN, serta proses klasifikasi menggunakan model LCNN. Model dilatih menggunakan *Adam optimizer* dengan mekanisme *Early Stopping* untuk mencegah *overfitting*.

Hasil pengujian menunjukkan bahwa model yang diusulkan mampu mencapai akurasi sebesar 83,56% dan *weighted average F1-score* sebesar 83,16% pada data uji. Hasil tersebut menunjukkan bahwa kombinasi *Mel-Spectrogram* dan PCEN mampu meningkatkan representasi pola spektral ucapan disartria sehingga membantu proses klasifikasi pada kelas dengan kemiripan fonetik. Selain itu, model LCNN yang digunakan tetap mempertahankan efisiensi komputasi sehingga sesuai untuk implementasi sistem klasifikasi ucapan berbasis *real-time*. Penelitian ini diharapkan dapat mendukung pengembangan teknologi asistif berbasis pengenalan ucapan bagi penderita disartria.

Kata Kunci: Disartria, *Mel-Spectrogram, Per-Channel Energy Normalization, Lightweight Convolutional Neural Network, Speech Command Recognition*

ABSTRACT

Dysarthria is a motor speech disorder caused by damage to the nervous system, resulting in reduced articulation clarity and communication difficulties. The development of automatic speech classification systems for individuals with dysarthria remains challenging due to unstable speech signal characteristics, high energy variations, and phonetic similarities between words. Therefore, an adaptive feature extraction method that can effectively represent the acoustic characteristics of speech and align with human auditory perception is required.

This study aims to develop a word-based dysarthric speech classification system using a Lightweight Convolutional Neural Network (LCNN) model with Mel-Spectrogram and Per-Channel Energy Normalization (PCEN) feature representations. The dataset used was obtained from the EasyCall Corpus, consisting of five word classes: no, stop, uno, zero, and invalid, with a total of 2,972 audio samples. The data were divided using the stratified split method with a ratio of 80:10:10 for training, validation, and testing datasets, respectively. The research stages included audio pre-processing, data augmentation, Mel-Spectrogram feature extraction, normalization using PCEN, and classification using the LCNN model. The model was trained using the Adam optimizer with an Early Stopping mechanism to prevent overfitting.

The experimental results showed that the proposed model achieved an accuracy of 83.56% and a weighted average F1-score of 83.16% on the test dataset. These results indicate that the combination of Mel-Spectrogram and PCEN effectively improves the representation of dysarthric speech spectral patterns, thereby enhancing the classification process for classes with phonetic similarities. In addition, the LCNN model maintained computational efficiency, making it suitable for real-time speech classification system implementation. This study is expected to support the development of speech recognition–based assistive technologies for individuals with dysarthria.

***Keywords**: Dysarthria, Mel-Spectrogram, Per-Channel Energy Normalization, Lightweight Convolutional Neural Network, Speech Command Recognition*