Identification of Auditory Biomarkers for Neurological Disorders

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Amyotrophic lateral sclerosis (ALS) is a neurodegenerative disorder that affects the nervous system, affecting millions worldwide. However, the early diagnosis of ALS is difficult since symptoms are often confused for other disorders. ALS patients have a hard time completing simple tasks due to their neuro-motor disruptions, making them dependent on automatic speech recognition (ASR) software for day-to-day tasks. Unfortunately, the strained or hypernasal voices of ALS patients results in a 78% failure rate in such software. This research proposes an innovative solution to identify auditory biomarkers for early diagnosis and a novel voice compensation method to improve voice recognition accuracy. To identify biomarkers, auditory features were extracted and frequency topography images were generated through the Mel-Frequency spectrogram to map frequency in time representation. The auditory features and the spectrogram images generated were processed using Machine Learning algorithms. The optimized Neural Network algorithm classifies voice files with an accuracy of 91% (auditory features) and 88% (spectrogram images). A new voice compensation algorithm was developed to adjust and compensate for a word's duration, frequency, pitch, and energy in order to improve the ASR recognition rate. This method successfully increases the voice recognition accuracy and allows ASR systems to understand voice commands from ALS patients easily. The methods in this research can be applied to other neurological disorders as well to identify auditory biomarkers and create a novel voice compensation algorithm. With the expanding field of machine learning, efficient diagnosing ALS patients and better novel voice compensation algorithms can now be a reality.