Early Diagnosis of Neurological Disorders by Detecting Irregularities in Speech

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MOTIVATION
- Early diagnosis of neurological diseases such as Parkinson’s, Alzheimer’s, Dementia etc.
- Almost all patients show signs of some sort of impairment in speech.
- Early diagnosis of neurological diseases may mitigate the effects.
- With the bandwidth increase in mobile devices, it is possible to obtain speech recording from the patients.

Speech signal examples
- Continuous speech from a normal person
- Signal with silent gaps from a patient with Alzheimer’s Disease
- Signal with silent gaps from a normal person and a patient with Alzheimer’s disease

Speech signal and spectrogram for a normal person and a patient with Alzheimer’s disease

Early generated Relevant possible Parkinson’s, Alzheimer’s, Dementia diseases

METHOD

Data Acquisition and Sensors
- Speech signal: Speech signals from microphones.

Feature Extraction from Sensors
- Measures of variation in fundamental frequency: Jitter, MDDP; RAP (KayPENTAX MDVP Relative Amplitude Perturbation)
- Measures of variation in amplitude: Shimmer, Shimmer: APQ3, APQ5, APQ7 (Three/Five/Seven point Amplitude Perturbation Quotient)
- Measures of ratio of noise to tonal components in voice: NHR (Noise-To-Harmonics Ratio)
- Nonlinear dynamical complexity measures detrended fluctuation analysis (DFA) Signal fractal scaling exponent: RPD (Recurrence Period Density Entropy), PPE (Three nonlinear measures of fundamental frequency variation)

MACHINE LEARNING ALGORITHMS

- Clustering Algorithms like K-means and MAP-DP
- Support Vector Machines (SVM) Classification and Outlier Detection using Kernel methods.

ANALYTICS

Real-Time Symptom Tracking
- Mobile Phones: App that tracks patients’ progression in disease.
- Online Software: Real-time interaction using speech.
- Fusing speech parameters with other signals
- Mixing speech analysis with other sensory parameters such as vision, motor reactions, gait, gestures, facial expressions etc.

Data collection
- Collection of more speech data with remote devices like smart phones and computers.

REFERENCES


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