Deep Learning Detection of Parkinson's Disease Diagnosis from Voice Data

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1   Abstract

Deep learning techniques have been developed in order to allow computer-aided diagnostic screening for various medical conditions. Parkinson's Disease (PD) is one of the conditions in which early detection can prove difficult as a patient in the early stages of the disease may present with few if any noticeable differences in comparison to a healthy individual. [5] Deep Learning algorithms have shown success at highlighting some of the early differences between healthy patients and those presenting with a disease at much earlier stages than typical diagnosis by a physician. [1] In this research a CNN is presented for detecting Parkinson's disease by utilizing a supervised dataset containing both features and raw recorded data from 20 Parkinson's Disease (PD) patients and 20 healthy subjects.

2   Motivation

PD is the second most common degenerative disorder affecting people in the United States. [2] Due to the symptoms of the disease there is a substantial burden on health care providers including friends and family. The associated costs (in 2002 USD) are also about 1.75 times higher on average for a person with PD compared to one without symptoms of the disease. [4] The diagnosis and treatment of PD typically occurs when the disease has progressed to an advanced stage where motor impairment is evident and neurophysiological damage has already occurred. [5] There are treatment options available for slowing the progression and symptoms of PD and if utilized early in the disease progression would improve the quality of life and reduce the costs associated with the disease. [5]

3   Methodology

Deep Learning methodologies are very good at discovering structures in high-dimensional data. It tends to be the best method for many speech recognition

cases thus making it a potentially good method for detecting changes in a users voice state caused by the advancement of PD. [3] By utilizing a supervised dataset a CNN will be utilized to establish whether or not a user presents with features associated with PD.
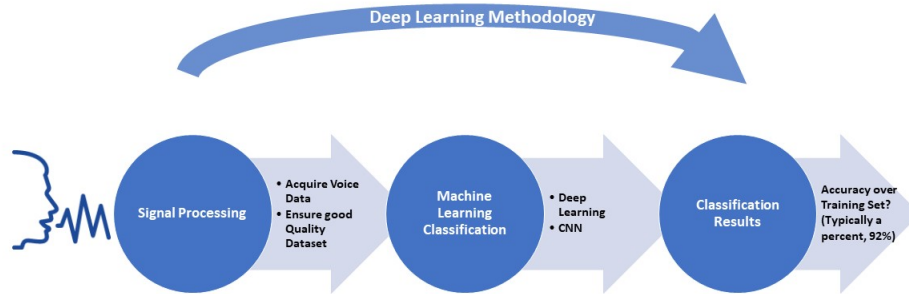
References

[1] Y. Ding, J. H. Sohn, M. G. Kawczynski, H. Trivedi, R. Harnish, N. W. Jenkins, D. Lituiev, T. P. Copeland, M. S. Aboian, C. Mari Aparici, S. C. Behr, R. R. Flavell, S.-Y. Huang, K. A. Zalocusky, L. Nardo, Y. Seo, R. A. Hawkins, M. Hernandez Pampaloni, D. Hadley, and B. L. Franc. A deep learning model to predict a diagnosis of alzheimer disease by using 18f-fdg pet of the brain. *Radiology*, page 180958. doi: 10.1148/radiol.2018180958. URL https://doi.org/10.1148/radiol.2018180958. PMID: 30398430.

[2] S. L. Kowal, T. M. Dall, R. Chakrabarti, M. V. Storm, and A. Jain. The current and projected economic burden of parkinson's disease in the united states. *Movement Disorders*, 28(3):311–318. doi: 10.1002/mds.25292. URL https://onlinelibrary.wiley.com/doi/abs/10.1002/mds.25292.

[3] Y. LeCun, Y. Bengio, and G. Hinton. Deep learning. *Nature*, 521:436 EP –, May 2015. URL https://doi.org/10.1038/nature14539.

[4] K. Noyes, H. Liu, Y. Li, R. Holloway, and A. W. Dick. Economic burden associated with parkinson's disease on elderly medicare beneficiaries. *Movement Disorders*, 21(3):362–372. doi: 10.1002/mds.20727. URL https://onlinelibrary.wiley.com/doi/abs/10.1002/mds.20727.

[5] Tinelli, Michela, Kanavos, Panos, and Federico. The value of early diagnosis and treatment in parkinson's disease: a literature review of the potential clinical and socioeconomic impact of targeting unmet needs in parkinson's disease, Mar 2016. URL `http://eprints.lse.ac.uk/68479`.