

## Parkinson's Disease

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Abstract	Background	Results
Our project studied the connection between Parkinson's disease (PD) and patients' voice recordings to determine whether certain vocal frequencies are a indicator for the disease. Our dataset contained a total of 31 patients with colum having different frequency rates recorded. We analyzed whether any of the frequencies were significantly different for those who have PD compared to tho who are healthy. Of those 31 patients in our dataset, 23 had Parkinson's diseas and 8 were healthy. We used a multilayer perceptron to classify our data, any concluded that there is in fact statistical evidence that a patient's voice can he doctors determine if they have PD. An activation function was used to help deci- whether the output should be used in our final perceptron. Backpropagation w used to train these multiple layers and determine the final weights in our data. C experiment we performed was our test and train data was split into a 80:20 ral first and then was switched to 60:40, as we did not have many patients in ou dataset that were healthy. This in turn helped us output a better result for our di Our study will be beneficial in the development of patient treatment by showi that something as simple as someone's voice can be used to determine wheth they have Parkinson's disease. Currently there is no recommended imaging or test for Parkinson's other than the dopamine transport (DAT) scan, which inclu	Parkinson's is a progressive disorder of the brain that begins as tremors, lack of affect in the face and loss of balance that can progress until walking or standing becomes impossible. As a result of the muscular malfunction caused by PD, patients may also experience a slowing or slurring of the speech and change in tone. These properties of speech can be measured as changes in the fundamental frequency of a patient, which will be examined in this project. This project will examine a new diagnostic tool for Parkinson's disease that may be more accurate and quantifiable than the existing method of diagnosis by symptoms alone. There is no imaging or lab test that can definitively diagnose PD, which requires physicians to rely on symptom analysis and the ruling out of other conditions. A specialized brain scan, the dopamine transporter (DAT) scan, can support a diagnosis, but is itself not definitive and requires specialized imaging equipment. If vocal recordings can prove to be diagnostic, physicians will have a cost-effective option for identifying Parkinson's in patients. In trural communities, this diagnostic tool could lead to quicker identification of PD in patients and thus better outcomes. Studies have shown that individuals with Parkinson's Disease do have a statistically significant lower fundamental vocal frequency variation compared to those not being treated. Another study has shown that the progression of PD impacts the severity of these vocal changes, with those individuals experiencing moderate PD showing a more severe limitation on their frequency range than those experiencing mild PD. <sup>4</sup> Bowen LK, Hands GL, Padnan S, Step CE. Effects of Parkinsor's Disease on Fundamental Frequency variability in Running Speech.J Med Speech Lang Pathol. 2013 Sep27(12):25-244. PMUC 2389754. PMUC PMC430272.	Kesuits         SVM         Model Accuracy w/o Hyperparameter Tuning:         81%         11 false positives, 0 false negatives         Model Accuracy w/ Hyperparameter Tuning:         93%         4 false positives, 0 false negatives         MLP         Accuracy:       95%         2 false negatives, 1 false positive
the injection of a radioactive tracer into the blood and requires specialized imagination	ng <sup>2</sup> 'Silbergleit AK, LeWitt PA, Peterson EL, Gardner GM. Quantitative Analysis of Voice in Parkinson Disease Compared to Motor Performance: A Pilot Study J Parkinsons Dis 2015;5(3):517-24 doi:10.3233/JPD-140526 PMID: 26406131	Conclusion
Methods           Our data consists of 24 features, one of which is a patient identified and serves no purpose for our research, and another which identified the patient's Parkinson's positivity status, which is our target label. The other 22 are various vocal measures of the patient.           The data includes 195 entries, representing the voice recordings of 3 patients, 23 of which have PD and 8 of which do not.           Our data features included many collinear measures of fundament. frequency variation and amplitude variation, vocal jitter and shimmer respectively. After eliminating these features, we were left with 10 t use for analysis in our models.           These features were then normalized by finding the z-scores of eac	r se 1 1) 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	We found a patient's Parkinson's status can indeed be determined by measuring their vocal features. The MLP model we developed achieved a 95% accuracy rate on our test data, a marginal increase over the accuracy of a properly tuned SVM. Further studies could examine if the severity of a patient's Parkinson could be measured through their vocal characteristics, or examine accuracy of such a model on a larger dataset with a more limited number of PD-positive individuals. <b>Future Direction</b> Considering our results, there should be a push in the research of diagnosing Parkinson's Disease. They should further pursue the diagnosis of vocal frequencie through trial and error to see what vocal frequencies work best in real life scenarios. With the research of PD vocal frequencies where the findings were concluded patients with mild PD, had their vocal frequencies hardly affected, there should be i
After normalization, we evaluated our data using two models, support vector machine (SVM) and multilayer perceptron (MLP). Th SVM had its hyperparameters tuned using the GridSearch function t achieve the highest level of accuracy in our prediction. The ML consisted of 2 hidden layers activated by the Rectifier Linear Un (ReLU) function and an output layer activated by the sigmoid function	a 3) 4) 4)	push for better testing equipment in order to find patients before they start ever showing symptoms PD. Acknowledgments Professor Rizk