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Classification of Parkinson's Using SVM

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Abstract—Parkinson's disease is a neurodegenerative condition that is typified by motor symptoms, such as recognizable alterations in gait. Timely diagnosis and efficient illness management can be facilitated by the early and accurate detection of certain gait abnormalities. In this work, we combine sensor-based analysis with machine learning and deep learning approaches to offer a unique strategy for Parkinson's disease gait diagnosis. This dataset consists of 31 individuals' biological voice measures, 23 of whom have Parkinson's disease (PD). Each row in the table corresponds to one of the 195 recorded datasets from these people ("name" column), and each column in the table represents a specific frequency measure of sensors. Based on the "status" column, the primary objective of the data is to distinguish between individuals with Parkinson's disease (PD) (1) and those who are healthy (0). Our results, which show 87% accuracy using the SVM method on the dataset, show how effective this strategy is. Whether or not the person has Parkinson's, the model demonstrated robustness in identifying gait characteristics unique to the disease. Furthering our comprehension of the disease-related gait abnormalities, we also discovered critical criteria that contribute to proper categorization by examining feature importance. Our method's potential for early, non-invasive Parkinson's disease detection makes it significant. We give clinicians an objective, quantitative tool to evaluate gait disorders through the use of wearable sensors and machine learning. Early intervention and individualized treatment plans could result from this strategy in better patient care. Finally, our work presents a novel approach to gait analysis in Parkinson's disease. The outcomes highlight the method's potential to transform the way Parkinson's disease is identified using deep learning and machine learning techniques, thereby improving the lives of those who are impacted.

Indexed Terms—Parkinson's, Gait Abnormalities, Neurodegenerative Disorder, Machine Learning, Deep Learning, SVM

I. INTRODUCTION

The ability to walk is a fundamental human function that we often take for granted. However, it is a remarkable interplay of physiological and neurological processes. These processes must work in harmony to ensure smooth and coordinated movement. When these processes are disrupted, particularly due to neurological conditions, it can lead to gait abnormalities. These abnormalities significantly impact an individual's mobility, balance, and overall quality of lifeNeurological gait abnormalities encompass a wide spectrum of disorders. They can result from conditions that affect various components of the nervous system, including the brain, spinal cord, nerves, and muscles responsible for coordinating and executing our movements. These abnormalities manifest in diverse ways, such as irregular step patterns, altered posture, unsteady movements, and reduced coordination. It is crucial to recognize that these abnormalities are not uniform but rather a complex array of symptoms and manifestations. One of the prominent conditions associated with neurological gait abnormalities is Parkinson's disease. Parkinson's disease is a neurodegenerative disorder that primarily affects the dopaminergic pathways in the brain. This leads to the classic motor symptoms of the disease, including slowness of movement, resting tremors, muscle rigidity, and postural instability. All of these symptoms can significantly disrupt one's ability to walk and maintain balance. Neurological gait abnormalities, including those caused by Parkinson's disease, have a profound impact on individuals. These challenges extend beyond physical limitations to affect their emotional and social well-being. Reduced mobility can lead to social isolation, depression, and a decrease in overall quality of life. As a result, addressing gait abnormalities is not just about restoring physical function but also about enhancing the holistic well-being of those affected.

II. LITERATURE REVIEW

The suggested deep learning model achieved an accuracy of 96.45%, demonstrating good detecting capability. This is mostly because of the deep learning model's desirable traits in terms of learning linear and nonlinear information.[1] The SVM, KNN, DT, RF, and MLP classifiers received their final features from both the t-SNE and PCA algorithms. All classifiers produced better outcomes for both PD diagnosis and normal cases. Using the t-SNE method, RF achieved 97% accuracy, 96.50% precision, 94% recall, and 95% F1-score during the testing phase. However, MLP achieved 98% accuracy, 96.66% precision, 96% recall, and 96.66% F1-score using the PCA technique [2]. In terms of accuracy, precision, recall, and combination measure F1, the provided technique was contrasted with various machine learning algorithms such as KNNs, SVM, NBs, MLP, DT, random tree, LR, SVM of RBFs, and combined classifiers. Furthermore, multiple tests have validated the high accuracy and early detection of the combination method that has been suggested. The short diagnostic time for the diagnosis of Parkinson's disease meant that the model was fast and accurate, with approximately 100% accuracy.[4] SVM and NN (neural network) were the most frequently used methods in the imaging studies, the usage for SVM (50%–70% used for SPECT or PET imaging, ~60% for MRI imaging) was higher than that of NN (22%–53% used for SPECT or PET imaging, ~23% for MRI imaging)[5] The value of applying machine learning methods in telemedicine to identify Parkinson's disease (PD) early and help patients with speech and mobility issues. Based on an analysis of MDVP audio data and four machine learning models, the Random Forest classifier is the most successful technique for early Parkinson's disease identification. With a sensitivity of 0.95 and an astounding accuracy of 91.83%, this model has a lot of potential to improve the lives of those who are at risk of Parkinson's disease, especially as the global aging population keeps growing.[6]

III. ALGORITHM

Supervised machine learning algorithm called Support Vector Machine (SVM) is used for regression as well as classification. Even so, issues with classification are the most appropriate use for regression problems. The SVM algorithm's primary goal is to locate the best hyperplane in a space with N dimensions that can be used to divide data points into various feature space classes. The hyperplane attempts to maintain the largest possible margin between the nearest points of various classes. The number of features determines the hyperplane's dimension. The hyperplane is just a straight line if there are only two input features.

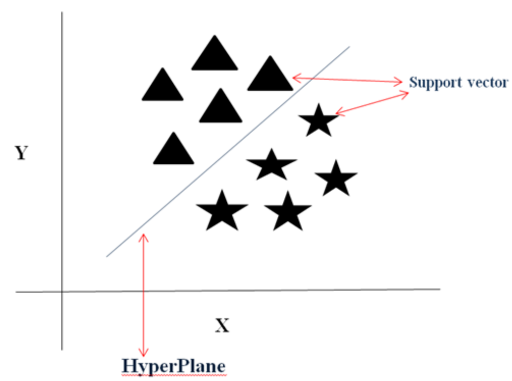

Figure 1: SVM Diagram

Support Vectors - The data points that are closest to the decision border (hyper-plane) that divides a classification problem's classes are referred to as support vectors in Support Vector Machines (SVMs). These support vectors are important because they can affect the decision boundary's direction and position. Support vectors are crucial in identifying the ideal hyperplane that optimizes the margin between classes, which is the goal of support vector machines (SVM).
Hyper-plane : A hyper-plane is a decision boundary in a Support Vector Machine (SVM) that divides data points into distinct classes in a classification issue. It

is a multidimensional surface that divides data points belonging to different classes. Finding the best hyper-plane that minimizes the margin—the distance between the hyper-plane and the closest data points from each class—is the aim of support vector machines (SVM). By categorizing fresh data points according to their position on the hyper-plane, this hyper-plane aids in the creation of precise forecasts.

IV. DATASET

The Proposed Flowchart display the working of SVM model using the data set of Biomedical Voice measurements of Parkinson's disease that was available on kaggle . The Model Train and Test the data in split of 80% for Training and 20% for Testing out of the Total 195 data 156 for Training and 39 for Testing and calculating its accuracy and plotting the confusion Matrix .The Predictive system Basically Predicts whether the model is accurate in classifying the dataset for those affected with Parkinson's and healthy .This Model works by manually feeding the data to the predictive system and then it classifies it either 0 or 1 that is Negative or Positive and Prints the result

V. RESULT

This Bar Graph shows how many people from the dataset are healthy and how many people are affected with Parkinson Diseases.

Healthy:- 48

Unhealthy-147

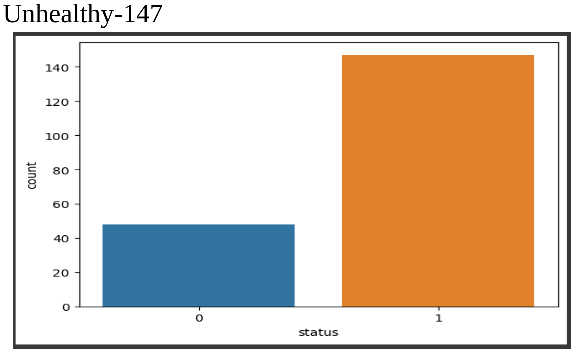

Figure 2: Bar Graph

Accuracy:

The percentage of correctly classified instances in the test set relative to all instances is known as accuracy. An accuracy of 0.8717 indicates that the SVM correctly classified 87.17% of the test set's instances. Given that the model correctly classifies a sizable portion of the test data, this suggests that the model is reasonably good at making accurate predictions. The SVM that we trained appears to perform well overall based on your test data, according to the results. It's crucial to remember that the context of your data and the particular issue you are attempting to solve should be taken into account when interpreting these results.

```
Accuracy: 0.8717948717948718
```

Figure 3: Accuracy

Confusion matrix

The result of running this code will be a heat-map visualization of the confusion matrix. The confusion matrix will help you understand how well your model is performing in terms of true positives, true negatives, false positives, and false negatives. The visualization provides an easy-to-interpret summary of classification results, allowing you to assess the strengths and weaknesses of your model. Confusion Matrix for the above SVM is as follows

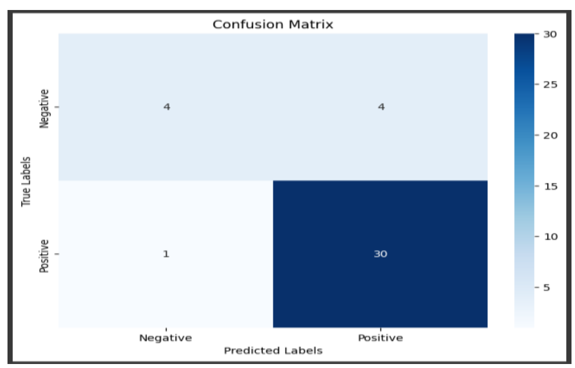

Figure 4 : Confusion Matrix

The Formula For Calculating The accuracy and confusion Matrix is Accuracy

= TP +TN / TP + TN + FP + FN

= 4 + 30 / 4+ 30 + 4 + 1 = 34 / 39 = 0. 8717

Prediction:

The summary of this code loads a dataset, prepares some input data, standardizes it, and then uses a machine learning model to predict whether a person has Parkinson's disease based on the input features. The result of the prediction is printed as either positive or negative.

```
[0]
Negative, No Parkinsons detected
/usr/local/lib/python3.10/dist-packages
  warnings.warn(
/usr/local/lib/python3.10/dist-packages
  warnings.warn(
```

```
[1]
Positive,Parkinsons detected
/usr/local/lib/python3.10/dist-package
  warnings.warn(
/usr/local/lib/python3.10/dist-package
  warnings.warn(
```

Figure 5: Prediction

Depending on the value of prediction, it prints whether Parkinson's disease is detected or not. If prediction [0] is equal to 0, it prints "Negative, No Parkinson's detected." Otherwise, it prints [1] "Positive, Parkinson's detected."

CONCLUSION

The proposed approach to develop a pathological healthcare system for the early detection of gait abnormalities using deep learning and machine learning techniques, specifically focusing on Parkinson's gait parameters, is a commendable endeavor in the field of medical diagnostics. The utilization of classification techniques Support Vector Machine (SVM) for this purpose demonstrates a systematic and data-driven approach The use of a dataset comprising biomedical voice measurements from individuals with and without Parkinson's disease is appropriate for the task. Voice recordings can provide valuable insights into a person's gait patterns, making it a potentially effective source of diagnostic information. The primary goal of classifying individuals into two categories based on their gait parameters, 0 for negative (healthy) and 1 for positive (Parkinson's disease), is a clear and relevant problem in the medical domain. The choice of SVM algorithms is well-suited for this classification task. SVM's capacity to find optimal hyper-planes in high-dimensional space is advantageous when dealing with complex data. Mentioning the use of a kernel trick with SVM implies the intention to capture non-linear relationships within the data. This is crucial, as gait abnormalities may exhibit complex patterns that cannot be adequately represented in a linear feature space.

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