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PRECISION MONITORING FOR PARKINSON'S DISEASE USING MACHINE LEARNING

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Abstract: Parkinson's disease is a neurodegenerative disorder affecting 60% of people over the age of 50 years. Patients with Parkinson's face mobility challenges and speech difficulties, making physical visits for treatment and monitoring a hurdle. Parkinson's Disease can be treated through early detection, thus enabling patients to lead a normal life.

This project highlights the use of Machine Learning techniques in telemedicine to detect Parkinson's Disease in its early stages. Researches evolved in recent years use Machine Learning and Deep Learning approaches for finding early stages of Parkinson's Disease. Through the use of XGBoost algorithm we are aiming at achieving high accuracy in the detection compared to other Machine Learning techniques

Keywords: Keywords for Precision Monitoring for Parkinson's Disease using Machine Learning include early detection, Parkinson's disease, audio signals, Machine Learning, classifier, gradient boosting, XGBoost, hyperparameter, accuracy and precesion.

I. INTRODUCTION

Parkinson's disease is a central nervous system disorder. Its symptoms occur because of low dopamine levels in the brain. Four Primary symptoms are tremor, rigidity, slow movement and balance problems. Till now no cure for Parkinson's Disease is known. Within the health care sector such needs have always led to application of technologies and evolution of new trends. These days machine learning has grown to become the fundamental key for advancing care and streamlining the data. Machine learning provides opportunities in health care to improve the accuracy of prognosis, personalization of treatment, and locate novel answers to many years-old troubles.

In this research, we will be analyzing the model to detect Parkinson's disease using one of the Classifier techniques known as XGBoost. We are considering the speech features of the patient for predicting whether the patient has Parkinson's disease or not. We'll be loading the dataset into the machine, get the features and targets, split them into training and testing sets, and finally pass them to XGBoost for prediction.

II. LITERATURE SURVEY

[1] W. Wang, J. Lee, F. Harrou and Y. Sun, "Early Detection of Parkinson's Disease Using Deep Learning and Machine Learning,". The following paper discusses the importance of early detection of Parkinson's disease (PD) and the use of data-driven techniques, particularly machine learning, in detecting PD. It also compares different data-driven methods, such as shallow machine learning, ensemble learning, and deep learning,

[2] C. Dong, Y. Chen, Z. Huan, Z. Li, B. Zhou and Y. Liu, "Static-Dynamic Temporal Networks for Parkinson's Disease Detection and Severity Prediction," the document proposes a new diagnostic model using optical flow and a force flow algorithm for gait analysis. It also discusses the limitations of current machine learning approaches in PD detection and severity prediction. The proposed model, called Static-Dynamic temporal networks, achieved better performance in gait detection and severity prediction compared to previous methods.

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[3] P. Warule, S. P. Mishra and S. Deb, "Time-Frequency Analysis of Speech Signal Using Wavelet Synchro-squeezing Transform for Automatic Detection of Parkinson's Disease," the file discusses a novel method for detecting Parkinson's disease (PD) using speech signals. The proposed approach involves using the wavelet synchro squeezing transform (WSST) to generate a time-frequency representation matrix (TFRM) of the speech signal.

[4] N. P. Narendra, B. Schuller and P. Alku, "The Detection of Parkinson's Disease from Speech Using Voice Source Information," Classification using standard-based representational disparity (SR) A method for measuring PD in speech. The way it turns is not good. Feature vectors are extracted from the training data. The idea is to formulate the detection problem as the problem of detecting the disparity between the feature vectors of the speaking test according to the instruction. model. The main advantage of using SR methods instead of traditional machine learning (ML)-based methods is that no training steps are required, which are time-consuming and require unstructured hyperparameter tuning.

[5] C. Laganas et al., "Parkinson's Disease Detection Based on Running Speech Data from Phone Calls," in IEEE Transactions on Biomedical Engineering, the study evaluates different approaches, such as feature extraction and shallow machine learning (ML) versus deep convolutional neural networks (CNNs), and discusses the impact of environmental conditions on voice recordings. The results show that while both approaches yielded promising results in some scenarios, they struggled to generalize across different datasets and environmental conditions.

III. SCOPE AND METHODOLOGY

Scope:
The main goal of this project is to understand what Parkinson's disease is and to detect the early onset of the disease, thus enabling the patients to get the treatment as early as possible. This approach focuses on understanding and implementing machine learning algorithms in health care industry for solving problems involving huge data and processing it for accurate outcomes. We aim at visualizing the results by confusion matrix, classification report, accuracy, recall, and precision for creating a precise, accurate and reliable early-stage Parkinson's Disease detection model.

Methodology:
Initially, a dataset containing voice recordings from Parkinson's and non-Parkinson's individuals is collected and preprocessed to extract relevant features like vocal tremors, pitch variations, and energy measures. Feature selection techniques are then applied to choose the most informative features. Next, the dataset is divided into training, validation, and test sets for model training, hyperparameter tuning, and evaluation, respectively. The XGBoost model is trained using the training data, optimizing parameters like learning rate and tree depth. Model performance is assessed using metrics like accuracy, precision, recall, and AUC-ROC on the test set. Interpreting the model reveals the importance of different voice features in Parkinson's detection. Once validated, the model is deployed for real-time predictions. Continuous monitoring and periodic retraining ensure ongoing model accuracy. Ethical considerations, such as data privacy and fairness, are also addressed throughout the process. This methodology ensures a robust and effective machine learning model for Parkinson's disease detection using voice-based features and XGBoost.

IV. SYSTEM ARCHITECTURE

Data used in this study were collected from 188 PD patients (107 men and 81 women) aged between 33 and 87 years, at the Neurology Clinic in Faculty of Medicine, Istanbul University. The control group consists of 64 healthy individuals (23 men and 41 women) aged 41 to 82 years. Exploratory Data Analysis (EDA) provides insights into the dataset, guiding feature selection.

The data is then split into training and testing sets. XGBoost, a powerful gradient boosting algorithm, is selected as the classification model. Hyperparameters are tuned for optimal performance during training. Evaluation metrics such as accuracy, precision, and recall assess the model's performance on the testing set. Feature importance is visualized to understand the contribution of different features.

Hyperparameter tuning is performed to enhance model performance further. If satisfied, the model can be deployed, and its results documented for future reference. Ethical considerations and data privacy are crucial throughout the process, particularly in healthcare-related projects.

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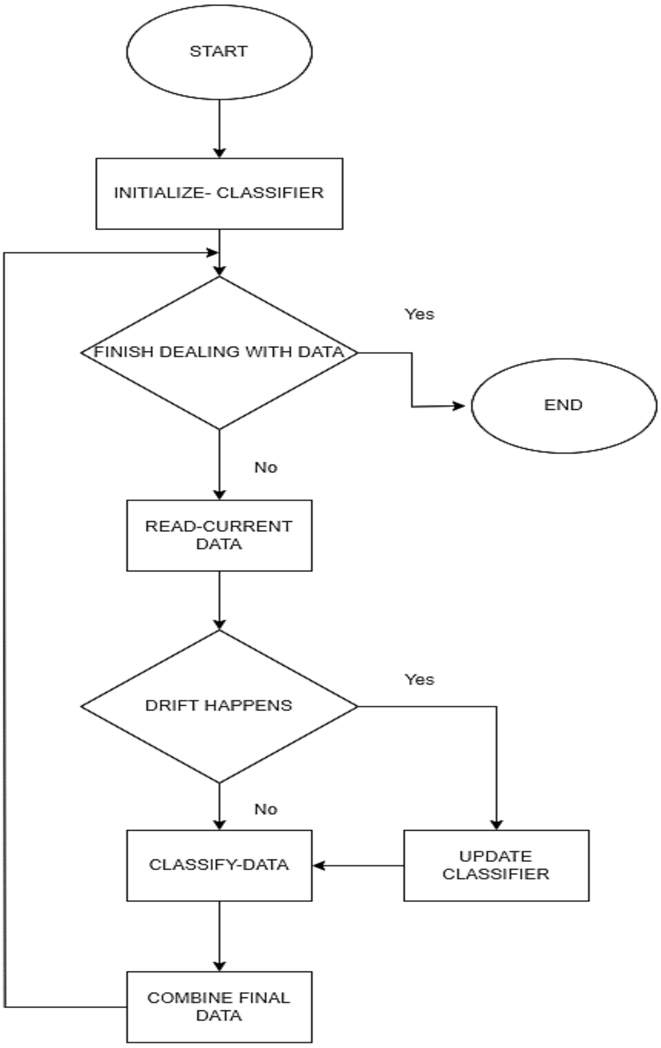

Fig.1 System architecture

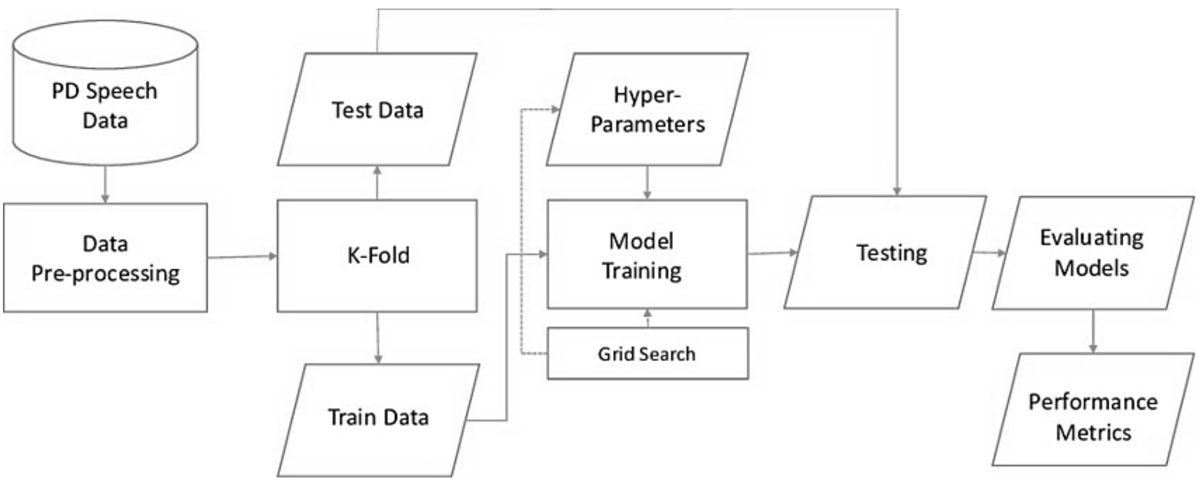

Fig.2 Activity diagram

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V. CONCLUSION

The early identification of Parkinson's Disease holds significant importance in gaining insights into its underlying causes. This research analyzes premotor features of Parkinson's Disease to distinguish between individuals in good health and those afflicted by Parkinson's Disease. The proposed Parkinson's Disease Detection model showcases an enhanced capability for Parkinson's Disease detection compared to other models, achieving a remarkable accuracy level of 97%. This achievement can be predominantly attributed to the amalgamation of diverse ML models. The experimental outcomes unequivocally establish the superiority of the Parkinson's Disease Detection model over other machine learning models and non-specialist diagnostic results.

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