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Parkinson's Disease Detection

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Abstract: Parkinson's Disease is a disorder that affects the nervous system. Parkinson's disease does not directly cause people to die but can make some people more vulnerable to serious and life-threatening infections. This research addresses the limitations of traditional clinical diagnosis by harnessing the potential of advanced data analysis techniques and machine learning algorithms. The project's primary objectives include dataset compilation, feature extraction, model development, multimodal fusion, model validation, and considerations for clinical applicability. The dataset will encompass a diverse range of participants diagnosed with PD as well as healthy controls, ensuring the representation of various demographic and clinical factors. By extracting distinctive features from voice recordings, handwriting dynamics, and gait patterns, the project aims to capture unique biomarkers associated with PD. Machine learning models, tailored for each modality, will be developed to classify individuals as PD-positive or PD-negative.

Keywords: Parkinson's Disease Detection, Machine Learning, Parkinson's Disease Classification, Convolutional Neural Network (CNN).

I. INTRODUCTION

Parkinson's disease, a chronic and progressive neurodegenerative disorder, affects millions of individuals worldwide, severely impacting their quality of life. Characterized by a wide range of motor and non-motor symptoms, the disease's early detection is paramount for effective management and intervention. The need for timely diagnosis has spurred innovative approaches to Parkinson's disease assessment, leading to the development of the Parkinson's DiseaseDetection Web Application. This user-friendly and non-invasive platform aims to harness the power of cutting-edge technology, combining the analysis of two distinct modalities—spiral drawings and voice samples to provide a comprehensive and accurate assessment of an individual's risk of Parkinson's disease.

The application provides users with the means to interact with a sophisticated system that combines state-of-the-art machine learning algorithms and multimodal data analysis. To provide a robust and accurate assessment, the application employs advanced machine learning algorithms. This approach involves training the machine learning model on a diverse dataset of individuals with and without Parkinson's disease. The model learns to differentiate between these groups, identifying patterns and correlations between the collected data and the presence of the disease. This model is at the heart of the Parkinson's Disease Detection Web Application, facilitating the integration of the analyzed drawing and voice data.

II. LITERATUREREVIEW

The proposed paper by Tapan Kuma [1] Parkinson's Disease (PD) is a chronic degenerative disease that mainly affects the nervous system and motor controls in human beings. Detecting Parkinson's Disease early is hard because the signs like stiff muscles, shaking, trouble balancing, and walking issues aren't easy to spot. Also, tests like blood tests and scans aren't very helpful in finding it early. So, doctors have a tough time diagnosing Parkinson's Disease early. Thirteen predictive models using various Machine Learning techniques have been formulated using the University of California, Irvine (UCI) dataset. A comparative study of these predictive models has been carried out on the UCI dataset consisting of biomedical voice recording samples of healthy and Parkinson Disease disease-affectedpeople.

Hung N. Pham [2] This study suggests using both voice and image tests together to improve how accurately we can identify patients with Parkinson's Disease. To support this idea, we examined data from voice tests and spiral tests using different machine learning techniques.

The results based on the two types of datasets demonstrate an excellent level of accuracy for PD identification. Pairwise correlation and k-means clustering techniques are used to extract features from the vocal dataset. In this classification problem, the highest accuracy of 95.89% is obtained using an ensemble of 3 classification models. The Person's correlation is used to extract features from the image dataset. They used KNN and Naïve Bayes algorithms.

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Korakanchi Madhu [3] In this Research paper our work is aimed to give a solution for people who doubt having PD as well as to give the intensity of disease for the people who are affected by PD. A machine learning algorithm has been used and any scan reports have not been used.

Only voice and spiral datasets are used. The model can be furtherdeveloped as a hybrid version of MRI or PET scans along with the spiral and voice dataset so that the accuracy can be further increased.

Zhaozhao Fung [4] developed a system forParkinson's disease. Parkinson's Disease (PD) is now the second most common degenerative disease among older people. A key aspect of PD is the loss of nerve function, which greatly impacts a person's ability to move. Right now, doctors mainly rely on noticing early signs of PD during check-ups, and this depends a lot on how much experience the doctor has. To establish an auxiliary diagnosis system for PD, this paper mainly introduces machine learning methods, specifically, the KNN algorithm, Random Forest algorithm, and Naive Bayesian algorithm are utilized to conduct group decisions for PD, where, an improved KNN algorithm with information entropy is proposed. The experiments on actual clinical data are designed and the comparison results show that this method does improve the prediction accuracy effectively and proves the feasibility of this method.

Yaqi Guan [5] in this paper, Parkinson's disease (PD) is a common neurodegenerative disease with low mortality but a high disability rate, and the prevalence gradually increases with age. "Hypomimia" is considered to be one of the common symptoms of Parkinson's patients.

The patient's eyes blink less often, their facial expression seems dull, and even when they try to show emotion, their face looks stiff, almost like they're wearing a mask. Using computer technology and machine learning, doctors can detect the disease in patients fairly quickly.

They also look into how facial expression problems relate to the severity of the disease in patients. The best threshold value found for accurately diagnosing the disease using a certain method is 90.06%. The results have practical significance and application value for objective diagnosis of Parkinson's disease.

Shakila Shafiq [6]: Parkinson's disease (PD) is a prominent neurodegenerative disease that damages the neurons of the substantia nigra, causing irreversible impairments leading to involuntary movements. Since Parkinson's Disease can seriously affect how patients live their daily lives as it progresses, finding it early is really important. Some methods inspired by nature have been suggested to detect Parkinson's Disease and help manage patients. Because there are many of these methods for choosing the most important features, we need to pair them with specific machine learning tools to get the best results for spotting the disease early. In this study, we picked 13 nature-inspired methods and 11 machine learning tools, then compared how well they work together to detect Parkinson's Disease.

III. PROPOSEDWORK

The proposed Parkinson's Disease Detection Web Application addresses these critical issues by offering an accessible, secure, and user-centric approach to early diagnosis.

Development of specialized machine learning models for each data modality (handwriting, gait) to classify individuals as PD positive or PD negative.

The proposed work would likely collect a diverse and comprehensive dataset comprising voice recordings, handwriting samples, and gait patterns from individuals with Parkinson's disease and healthycontrols. Inclusion of a wide range of demographic, clinical, and symptom-related variables to ensure dataset representativeness.

To enhance accessibility and usability, the system will feature both a user-friendly website and a mobile application.diagnostic tool that utilizes handwriting samples, and gait patterns to accurately distinguish between individuals with PD and healthy controls. A human can easily capture images of their hand written spiral and upload them for disease diagnosis.

In addition to facilitating disease detection, the platform will also serve as an educational resource for farmers. It will provide valuable information on disease management strategies, treatment options, and preventive measures. By empowering farmers with knowledge and actionable insights, the system aims to enable them to effectively combat plant diseases, ultimately improving crop yields and productivity.

Overall, the proposed system utilizes image processing and voice recognition methods, specifically CNNs, to automate the detection of Parkinson's disease.

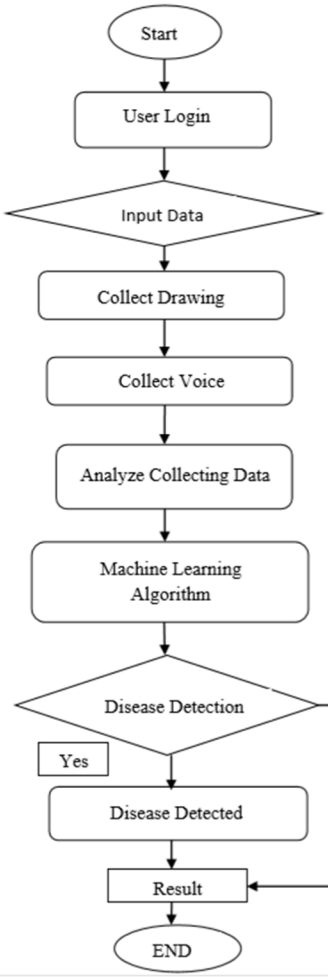


Figure: 1Flowchart

Fig 2 Represents the architecture of the Parkinson's disease detection system. The deep learning approach extracts intricate patterns and features from the drawn spirals, aiming to capture subtle motor abnormalities that may indicate the presence of Parkinson's disease.

1) *Data Collection Module:* Functionality: Responsible for collecting voice recordings, handwriting samples, and relevant demographic and clinical information from PD-positive individuals and healthy controls.
2) *Data Preprocessing Module:* Functionality: Cleans and prepares the collected raw data for feature extraction and model training. Submodules: Voice Preprocessing: Cleans and normalizes voice recordings, and extracts vocal features. Handwriting Preprocessing: Converts handwriting samples into suitable image-like formats, and processes pen dynamics.

3) *Individual Modality Models Module - CNN:* Develops CNN models specific to each modality: Voice CNN: Analyzes vocal feature spectrograms to classify PD-positive and PD-negative cases. Handwriting CNN: Utilizes image-like handwriting representations for classification.

4) *User Management*

a) *User Registration:* Users should be able to create accounts with their personal information, including a unique username and password.
b) *User Login:* Registered users must have the ability to log in securely to access the application.
c) *Use Profile Submission:* Users should be able to update and manage their profiles, including personal information and preferences.

5) *Data Submission*

a) *Spiral Drawing Submission:* Users must be able to upload scanned or digital spiral drawings as a part of the assessment.

b) *Voice Sample Submission:* Users should be able to record and submit voice samples for assessment through the application.

6) *Data Handling and Storage:* The application should securely store user-submitted data, including spiral drawings and voice samples.

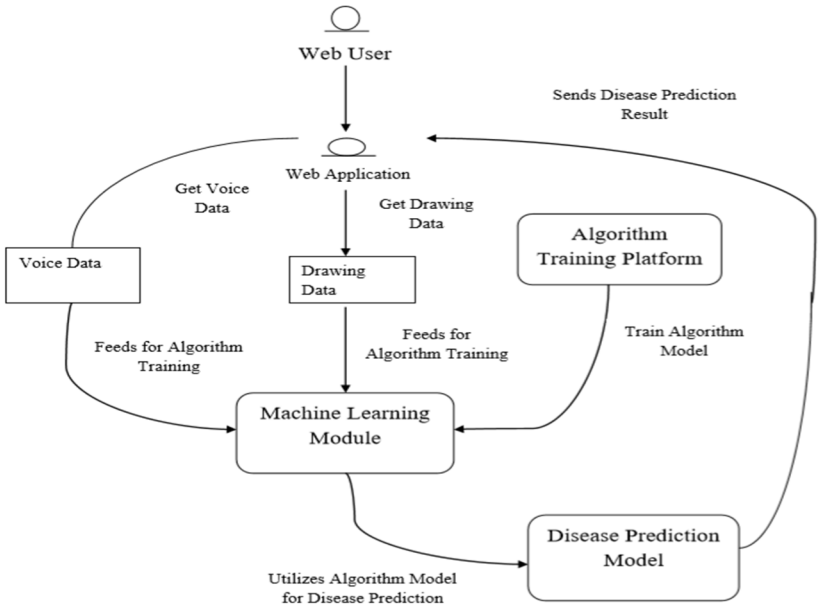


Figure: 2 Architecture Diagram

IV. CONCLUSION

In Conclusion, the Parkinson's Disease Detection Web Application embodies the spirit of innovation in healthcare technology, aiming to enhance early detection and empower individuals to take proactive steps toward better health. While it has limitations and challenges, its potential benefits in terms of early diagnosis, user engagement, and public health make it a valuable addition to the field of Parkinson's disease assessment and research.The Parkinson's Disease Detection Web Application represents a promising and innovative approach to the early detection of Parkinson's disease, offering numerous advantages and the potential to make a meaningful impact on individuals' health and well-being. This groundbreaking application empowers users to assess their risk of Parkinson's disease conveniently and non-invasively, fostering a sense of control and awareness.

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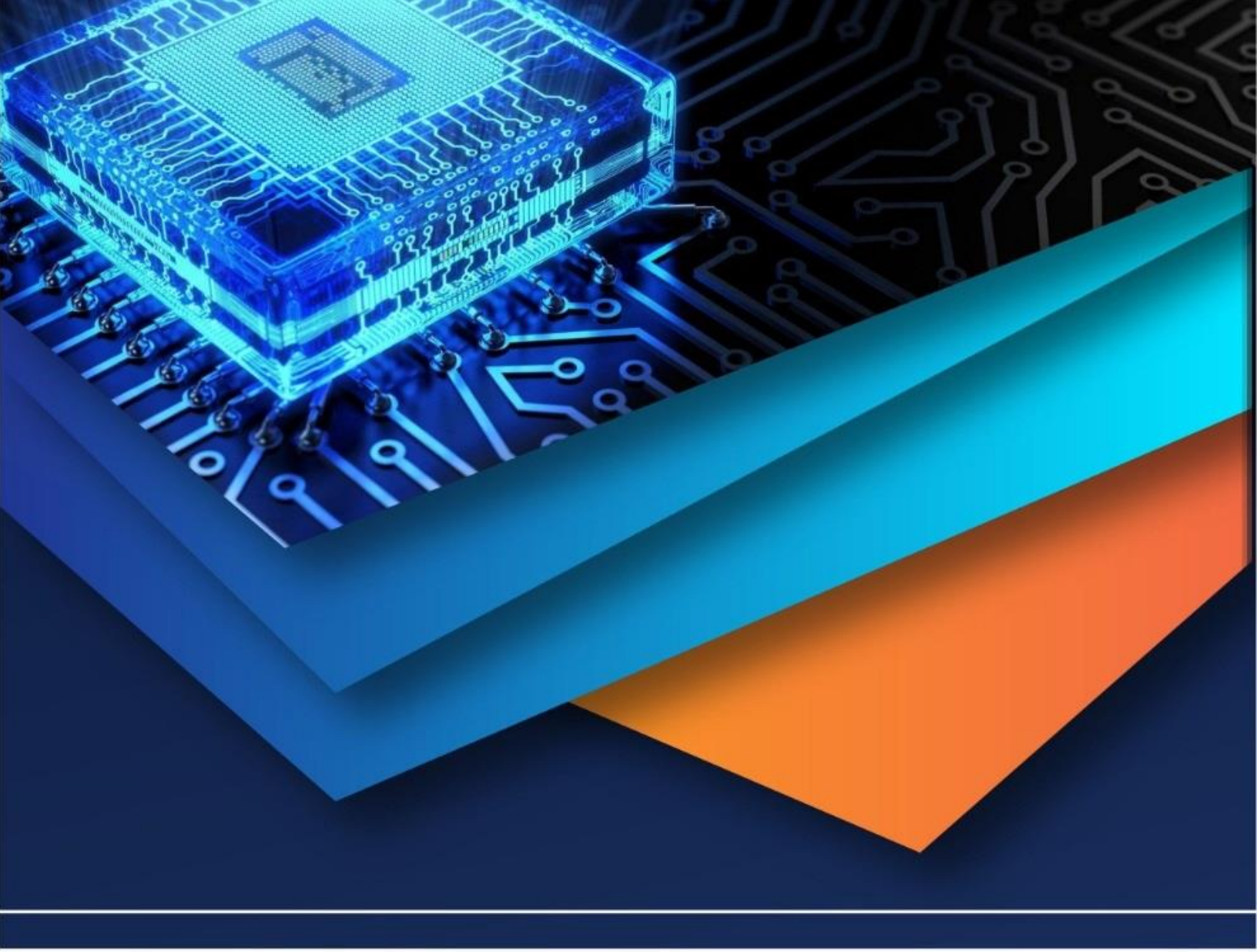
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