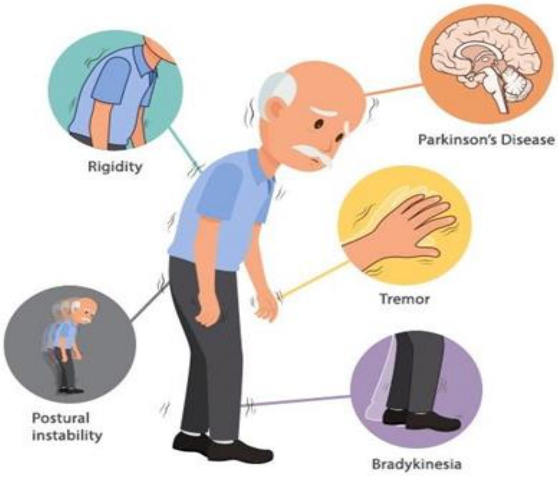
Recognizing Parkinson's illness Using Spiral and Wave Patterns Hand-Drawn

[1]Chennakesava Rao M, [2]kanamarlapudi N V S Rama Manikanta, [3]Bathula Harshith, [4]Chebrolu Soma Sekhar, [5]Krapa Bindu Sagar Naidu

[1]Associate Professor, Department of CSE-AI&ML, Kallam Haranadhareddy Institute of Technology, Guntur, AP, India.
[2,3,4,5] B.Tech Students, Department of CSE-AI&ML, Kallam Haranadhareddy Institute of Technology, Guntur, AP, India.

ABSTRACT
Research in biometrics has grown substantially in recent years with an increasing number of applications. One of the most important applications is healthcare. Identification of the appropriate biomarkers with respect to particular fitness problemsand detection of the same is of paramount significance for the improvement of medical decision assistance systems. For the sufferers laid low with Parkinson's Disease (PD). It's been duly found that impairment in the handwriting is directly proportional to the severity of the sickness. Also, the velocity and pressure implemented to the pen while sketching or writing something also are much lower in sufferers affected by Parkinson's disorder. Therefore, successfully figuring out such biomarkers accurately and precisely at the onset of the disorder will result in a better medical diagnosis. Therefore, a system is designed for studying Spiral drawing patterns and wave drawing patterns in sufferers affected by Parkinson's disease. With the help of various Machine Learning Algorithms, we will be able to analyse the spiral pattern and wave pattern and check whether the person is suffering from Parkinson's Disease or not.

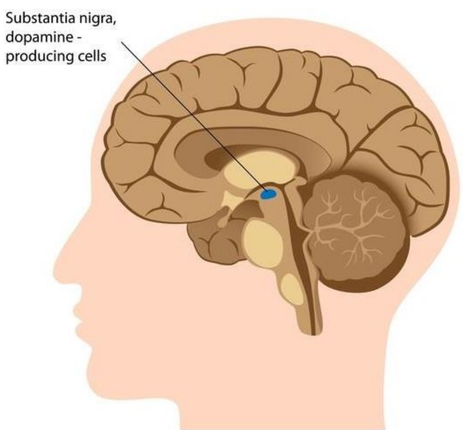
I. INTRODUCTION
Parkinson's Disease is a progressive neurodegenerative disorder that causes weakness in the muscles and uncontrollable shaking of the arms and legs. It is a chronic condition that worsens over time, significantly affecting the lives of those diagnosed with it. With a prevalence rate of around 1% among individuals above 60 years old, Parkinson's Disease has become a global health concern. In recent years, there has been a growing interest in using machine learning techniques and algorithmsto address the challenges associated with diagnosing Parkinson's Disease. Traditional diagnostic tests oftenfall short in providing accurate and objective assessments, asthey heavily rely on subjective interpretation of motor signs and symptoms. These symptoms can be subtle and difficult to detect, making early diagnosis challenging.



To overcome these limitations, researchers have turned to machine learning methods to enhance the diagnostic and evaluation processes for Parkinson's Disease. By analysing a diverse range of data modalities, including patterns in handwriting, machine learning models can effectively differentiate between individuals with Parkinson's Disease and healthy controls or patients with similar medical presentations.

By leveraging the power of machine learning algorithms, these models provide a more objective and reliable approach to diagnosing Parkinson's Disease. They enable healthcare professionals to detect and classify the disease with greater accuracy, minimizing misclassification and improving early diagnosis rates. This, in turn, allows for more timely intervention and tailored treatment strategies, ultimately improving the quality of life for individuals living with Parkinson's Disease. Theintegration of machine learning techniques into healthcare holds immense promise, notonly for Parkinson's Disease but also for various other medical conditions. As technology advances and datasets continue to expand, machine learning algorithms are expected to play an increasingly significant role in revolutionizing medical diagnostics and decision-making processes. Identifying Parkinson's disease through hand-drawn spiral and wave patterns involves leveraging the unique motor symptoms exhibited by individuals with the condition. Parkinson's disease is a progressive neurodegenerative disorder characterized by tremors, rigidity, bradykinesia (slowed movement), and postural instability. These motor symptoms can affect various daily activities, including handwriting and drawing.

Parkinson's disease



Researchers and healthcare professionals have found that analyzing hand- drawn spiral and wave patterns can provide valuable insights into motor function and aid in the diagnosis and monitoring of Parkinson's disease. Individuals with Parkinson's often exhibit distinct alterations in their motor control, resulting in characteristic deviations from typical drawing patterns.

The existing system for Parkinson's disease identification relies on a combination of clinical assessments, medical history review, and sometimes specialized diagnostic tests. Neurologists typically conduct clinical assessments to evaluate motor symptomsassociated with Parkinson's disease, including observing tremors, rigidity, slowness ofmovement, and postural instability. Additionally, physicians review the patient's medical history to identify relevant symptoms, family history, and potential risk factors, providing a holistic understanding of the patient's health status.

Furthermore, traditional diagnostic tools like the Unified Parkinson's Disease Rating Scale (UPDRS) are commonly used to assess the severity of symptoms. These assessments evaluate various aspects such as behavior, mood, activities of daily living, and motor function. While imaging techniques such as MRI or DaTscan can detect brain changes associated with Parkinson's disease, they are not routinely used for diagnosis. Instead, the existing system relies on the expertise of healthcare professionals to integrate clinical assessments, medical history, and sometimes imaging studies to accurately diagnose Parkinson's disease and initiate appropriate treatment plans.

II. LITERATURE SURVEY

In a study by Anastasia Moskova et al. [1], a system was developed to detect Parkinson's Disease by capturing hand movements using a Leap Motion Sensor. They applied machine learning algorithms such as KNN, SVM, Random Forest, and Decision Tree to the obtained data, achieving an overall accuracy of 95.3%. In another research paper by Shrihari K Kulkarni et al. [2], various machine learning algorithms including XGBoost, CNN, ANN, Logistic Regression, Random Forest, SVM, Boosted Trees, and RNN were employed to detect Parkinson's Disease. The study reported an overall accuracy of 94.5%.
Jaichandran R et al. [3] utilized K Mean Clustering and Decision Tree algorithms to detect Parkinson's Disease, achieving an overall accuracy of 85%. Sabyasachi Chakraborty et al. [4] focused on analyzing spiral and wave drawings of healthy and Parkinson-affected patients. They applied Logistic Regression, Random Forest Classifier, and CNN algorithms, resulting in an overall accuracy of 93.3%.
Ferdib-Al-Islam and Laboni Akter [5] employed various machine learning algorithms such as Decision Tree, Gradient Boosting, KNN, Random Forest, HOG feature descriptor, and Logistic Regression on hand-drawn images of healthy and affected individuals. Their research yielded an overall accuracy of 89.33%. Md. Sakibur Rahman Sajal et al. [6] conducted tremor and voice analysis of individuals with Parkinson's Disease. They utilized KNN, SVM, Naïve Bayes, and MRMR Feature Selection algorithms, achieving an overall accuracy of 99.8%.
In the study by Priyadharshini et al. [7], voice analysis of Parkinson-affected patients was performed, and the XGBoost algorithm was applied, resulting in an accuracy of 92.76%. Basil K Varghese et al. [8] investigated speech datasets and utilized machine learning techniques such as SVR, Decision Tree Regression, Linear Regression, and SVM. Their research reported an overall accuracy of 92.9%. Timothy Wroge et al. [9] analyzed voice datasets of both healthy individuals andthose with Parkinson's Disease. They employed machine learning algorithms including CNN, SVM, Decision Trees, Random Forest, and Artificial Neural Network, achieving an overall accuracy of 86%. In summary, these studies have demonstrated the effectiveness of machine learning algorithms in detecting Parkinson's Disease using various data modalities such as hand movements, speech, and voice analysis. Each study utilized different algorithms and achieved promising overall accuracies, highlighting the potential of machine learning in improving diagnostic capabilities for Parkinson's Disease.

REVIEW FINDINGS

Identifying Parkinson's disease through hand-drawn spiral and wave patterns has beena topic of interest in recent research. Here are some key findings:

1. Motor Symptoms Detection: Studies have shown that individuals with Parkinson's disease exhibit characteristic motor symptoms, including tremors, rigidity, and bradykinesia (slowed movements). These motor symptoms often manifest inhandwriting and drawing tasks, such as drawing spirals or waves.
2. Quantitative Analysis: Researchers have developed algorithms and software toolsto quantitatively analyze hand-drawn spiral and wave patterns. These tools assess various parameters such as the amplitude, frequency, smoothness, and symmetry of the drawings.
3. Differentiation from Healthy Controls: Research has demonstrated that individuals with

Parkinson's disease tend to produce spirals and waves with lower amplitudes, reduced smoothness, and altered symmetry compared to healthy controls. These differences can be detected through quantitative analysis of the drawings.

4. Potential Diagnostic Aid: Hand-drawn spirals and waves have shown promise as a non-invasive and cost-effective tool for aiding in the diagnosis of Parkinson's disease. They can complement traditional diagnostic methods such as clinical assessment and neuroimaging techniques.

5. Challenges and Limitation: While hand-drawn spirals and waves offer potential asa diagnostic aid, there are challenges and limitations to consider. Variability in drawing abilities among individuals and factors such as age, cognitive impairment,and medication effects can influence the results.

6. Future Directions: Future research efforts may focus on refining quantitative analysis techniques, exploring the use of digital drawing platforms for standardized assessments, and investigating the utility of hand-drawn patterns in longitudinal monitoring of disease progression and treatment efficacy.

III. PROPOSED WORK

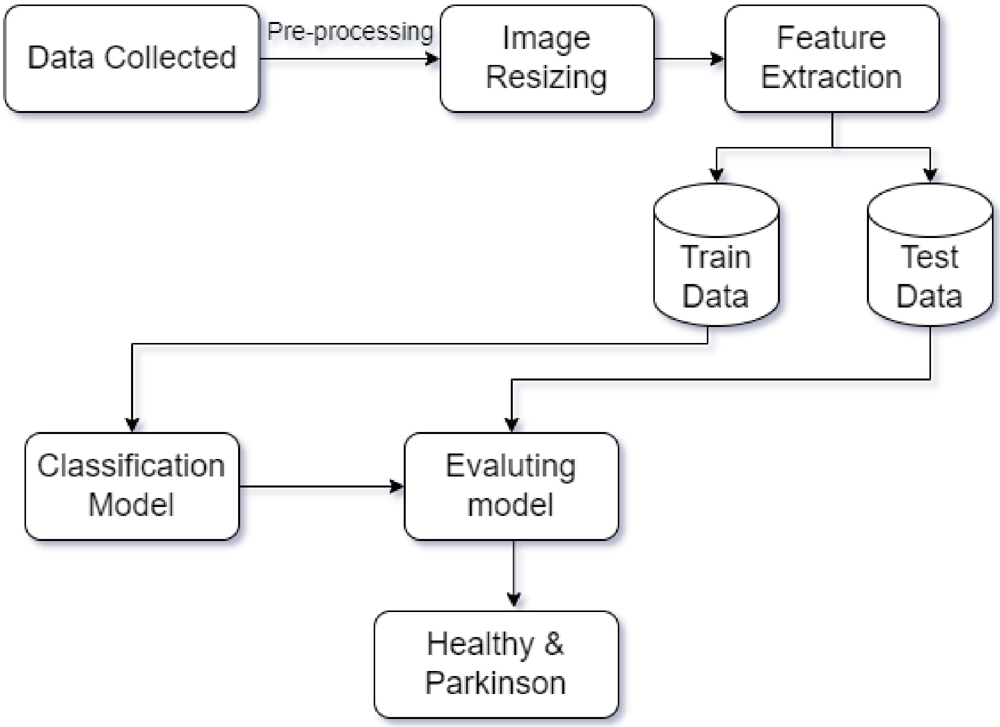
In this proposed system using the Random Forest algorithm for detecting Parkinson's disease through hand-drawn patterns, patients first create specific drawings, like spirals or waves, either on paper or digitally. These drawings are then analyzed by a computer program. It extracts features from the drawings, such as how shaky the lines are or if there are any irregularities. These features are fed into the Random Forest algorithm, a type of computer program that learns patterns from data. It's trained on a dataset containing examples of drawings from both Parkinson's patients and healthy individuals. Once trained, the algorithm can classify new drawings as either indicative of Parkinson's disease or not, helping healthcare professionals make more accurate diagnoses.

This system integrates with traditional clinical assessments, offering an additional tool for diagnosis. Healthcare professionals can combine the results from the algorithm with other tests and patient history for a more comprehensive evaluation. Validation studies are conducted to ensure the system's accuracy and effectiveness across different patient groups.

Advantages of the Proposed System:

The proposed system utilizing the Random Forest algorithm for Parkinson's disease identification offers several advantages over the existing methods. Firstly, it provides a quantitative and objective approach to analyzing hand-drawn patterns, enhancing diagnostic accuracy by identifying subtle abnormalities that may not be apparent to the naked eye. This quantitative analysis enables the detection of early-stage Parkinson's disease, potentially allowing for earlier intervention and better patient outcomes. Secondly, the integration of machine learning techniques like Random Forest facilitates automated and efficient processing of large volumes of data, leading to faster diagnosis and reduced burden on healthcare professionals. The system can analyze a wide range of features extracted from hand-drawn patterns, providing a comprehensive assessment of motor function and aiding in differential diagnosis.

Additionally, the proposed system offers the potential for remote monitoring and telemedicine applications, allowing patients to perform drawing tasks from the comfort of their homes. This accessibility can improve patient engagement and facilitate regular monitoring of disease progression. Furthermore, the system's scalability and adaptability make it suitable for diverse patient populations and healthcare settings, contributing to its widespread adoption and utility in clinical practice. Architectural view of entire proposed system is shown in the belowfigure3.8 talks about how the data is collected from the kaggle. And the collected datais stored in the data set and next we will preprocess the data set and split the data set into two groups and evaluate the results.



FArchitecture Diagram.

The architecture begins with the collection of medical imaging data from the Kaggle dataset, which contains spiral and wave images with annotations. This data serves as the foundation for model training and evaluation. The collected data undergoes augmentation using techniques such as noise, flipping, and blur to increase dataset variability and improve model generalization. Roboflowis utilized for automated augmentation, ensuring efficient generation of augmented training data.

The augmented data is then used to train a Convolutional Neural Network (CNN) model, selected based on its suitability formed ical image analysis. The CNN architecture is customized and optimized to detect lung tumors effectively. The training phase involves feeding the augmented dataset into the CNN model to learn features and patterns indicative of lung tumors. Techniques such as transfer learning and fine-tuning may be employed to leverage pre-trained models and accelerate training.

Following training, the model is evaluated using a separate test dataset to assess its performance. Evaluation metrics such as accuracy, precision, recall, and F1-score are computed to gauge the model's effectiveness in tumor detection. The testing results are analyzed to identify areas of strength and improvement in the model's performance. Visualization tools may be utilized to interpret model predictions and highlight regions of interest within the medical images. Once the model has been trained and evaluated, it is deployed within a Flask application, providing clinicians with a user-friendly interface for uploading medical images and receiving tumor predictions. This deployment enables real-time interaction and decision-making based on the model's outputs.

ALGORITHMS DESIGN

An algorithm is a series of instructions, often referred to as a “process,” which is to be followed when solving a particular problem While technically not restricted by definition, the word is almost invariably associated with computers, since computer processed algorithms can tackle much larger problems than a human, much more quickly Since modern computing uses algorithms much more frequently than at any other point in human history, a field has grown up around their design, analysis, and refinement The field of algorithm design requires a strong mathematical background, with computer science degrees being particularly sought-after qualifications It offers a growing number of highly compensated career options, as theneed for more algorithms continues to increase.

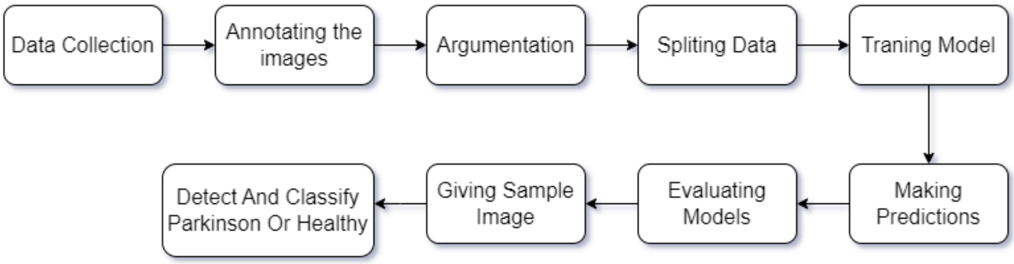


Fig: Algorithm Design

IV. OUTPUT SCREENS

Fig: predict the emotion of tweet message.

As fig 4.1 shows as the user needs to enter an id and posts the tweet he likes and canclick the predict option to predict the emotion of the textual tweet.

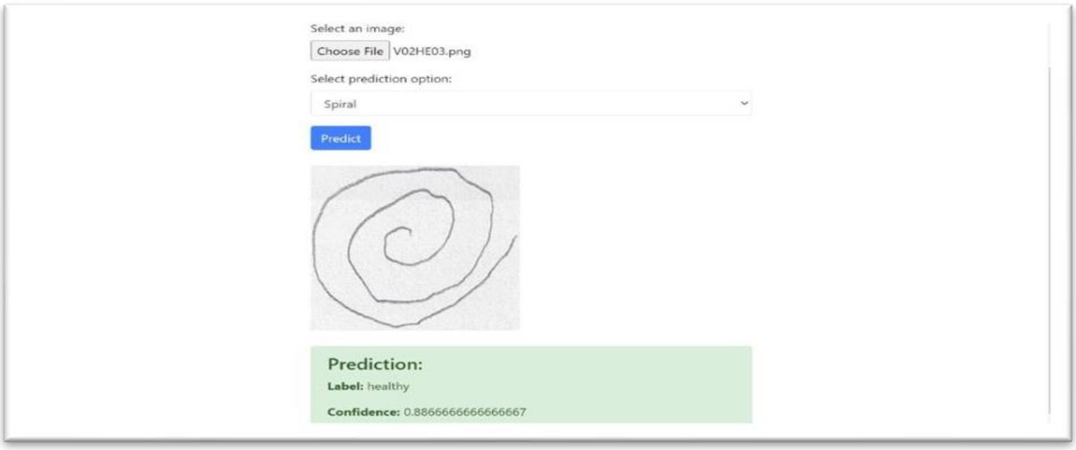


Fig: Result - Healthy

Fig: Result - Parkinson

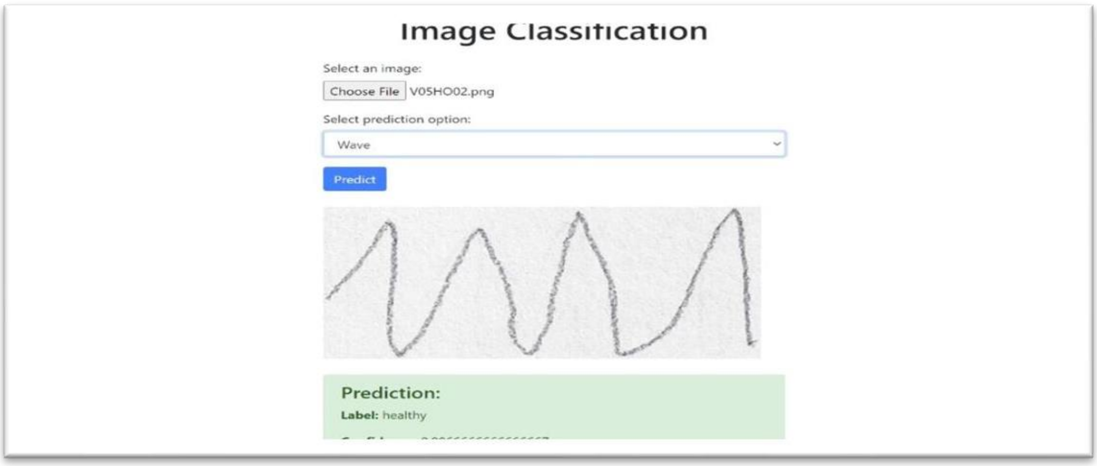


Fig: Result - Healthy

Fig: Result - Parkinson

V CONCLUSION AND FUTUREENHANCEMENTS

CONCLUSION

In conclusion, the project aiming to develop a system for Parkinson's disease identification using hand-drawn spirals and wave patterns holds significant promise inrevolutionizing the diagnostic process for this debilitating neurological condition.Through a comprehensive feasibility study, it has been established that the proposed system addresses critical technical, financial, market, regulatory, operational, andbehavioral considerations.

The system offers unique features such as personalized analysis, real-time feedback, progress tracking, integration with wearable devices, interactive visualization, remote monitoring, and collaborative decision support. These features not only enhance the accuracy and efficiency of Parkinson's disease diagnosis but also improve patient engagement and convenience.

Moving forward, it is imperative to continue the development and refinement of the system, incorporating feedback from stakeholders and ensuring compliance with regulatory standards. Collaboration with healthcare professionals, patients,researchers, and industry partners will be essential in achieving widespread adoption and maximizing the impact of the system on improving patient outcomes and quality of life.

Ultimately, the successful implementation of the project has the potential to transformthe way Parkinson's disease is diagnosed and managed, providing earlier detection, personalized treatment strategies, and improved patient care. This endeavor represents a significant advancement in the intersection of healthcare and technology, with the ultimate goal of making a meaningful difference in the lives of individuals affected byParkinson's disease.

FUTURE ENHANCEMENTS

Future enhancements of the project could focus on several areas to further improve its effectiveness and usability. These enhancements may include:

Advanced Machine Learning Algorithms: Incorporating more advanced machine learning techniques could enhance the system's ability to detect subtle patterns in hand-drawn spirals and wave patterns, leading to even more accurate and reliable diagnostic results.

Multi-modal Data Integration: Integrating data from multiple sources, such as voice recordings or gait analysis, in addition to hand-drawn spirals and wave patterns, could provide a more comprehensive picture of Parkinson's disease symptoms and progression.

Longitudinal Analysis: Implementing tools for longitudinal analysis could enable the tracking of changes in drawing patterns over time, allowing for early detection of disease progression or treatment effectiveness.

Enhanced User Experience: Continuously improving the user interface and experience based on feedback from patients and healthcare professionals could increase user engagement and satisfaction with the system.

Incorporation of Biomarkers: Exploring the integration of biomarkers, such asbiochemical or imaging markers, alongside hand-drawn spirals and wave patterns, could provide additional diagnostic information and improve overall accuracy.

Validation Studies: Conducting large-scale validation studies to assess the system's performance in diverse populations and clinical settings could further establish its reliability and effectiveness as a diagnostic tool.

Telemedicine Integration: Integrating the system with telemedicine platforms could facilitate remote consultations and monitoring, expanding access to diagnostic services for patients in underserved areas or those with limited mobility.

Continuous Research and Development: Investing in ongoing research and development efforts to stay abreast of advancements in technology and medical knowledge will be essential for keeping the system at the forefront of Parkinson's disease diagnosis and management.

8.1 REFERENCES

[1].Machine learning technique-based Parkinson's disease detection from spiral and voice inputs, Jaichandran R Leelavathy S Usha Kiruthika S Goutham Krishna Mevin John Mathew Jomon Baiju, European Journal of Molecular & Clinical Medicine, 2020, Volume 7, Issue 4, Pages 2815-2820.

[2]. Ferdib-Al-Islam and L. Akter, "Early Identification of Parkinson's Disease from Hand-drawn Images using Histogram of Oriented Gradients and Machine Learning Techniques," 2020 Emerging Technology in Computing, Communication andElectronics (ETCCE), 2020, pp. 1-6, Doi: 10.1109/ETCCE51779.2020.9350870

[3].Senturk, Z. K. (2020). Early diagnosis of Parkinson's disease using machine learning algorithms. Medical hypotheses, 138, 109603.

[4].Aversano, L., Bernardi, M. L., Cimitile, M., Iammarino, M., & Verdone, C. (2022,July). Early Detection of Parkinson's Disease using Spiral Test and Echo State Networks.

[5].Zham P, Kumar DK, Dabnichki P, Poosapadi Arjunan S and Raghav S (2017) Distinguishing Different Stages of Parkinson's Disease Using Composite Index of Speed and Pen-Pressure of Sketching a Spiral

[6]. Alex Li, Chenyu Li "Detecting Parkinson's Disease through Gait MeasuresUsing Machine Learning". https://www2.mdpi.com/2075-4418/12/10/2404-2022

[7]. Broeders M., De Bie R.M.A., Velseboer D.C., Speelman J.D., Muslimovic D., Schmand B. Evolution of mild cognitive impairment in Parkinson disease. Neurology.2013;81:346–352. doi: 10.1212/WNL.0b013e31829c5c86. [PubMed] [CrossRef] [Google Scholar]

[8]. Goldman J.G., Aggarwal N.T., Schroeder C.D. Mild cognitive impairment: An update in Parkinson's disease and lessons learned from Alzheimer's disease. Neurodegener. Dis. Manag. 2015;5:425–443. doi: 10.2217/nmt.15.34. [PMC free article] [PubMed] [CrossRef] [Google Scholar]