# Detecting Parkinson's Disease using Machine Learning

## INTRODUCTION:

Welsh (2008) defines Parkinson's disease (PD) as a chronic progressive neurodegenerative disease with main motor symptoms in the form of rigidity, rest tremor, bradykinesia, and postural instability. Symptoms become more severe with the progression of the disease and non-motor symptoms such as autonomic, sleep, neuropsychiatric dysfunctions, and pain might appear, which increases the patient's dependency on help to cope with everyday life (Welsh 2008). In Finland, there are about 10 000 PD patients, and in the population of age over 70 almost every second is diagnosed with PD. The purpose of the thesis was to describe patient education for PD patients. The ultimate goal was to improve the quality of nursing care and increase PD patients' knowledge of their treatment and in that way improve patients' daily life by using machine learning.

In this project, we are using a machine learning model to create to detect Parkinson's disease and provide a better awareness of Parkinson's disease, the best home possible remedies and a list of contact information to consult doctors.

# ABSTRACT:

Parkinson's disease is one of the supreme neurodegenerative problems of the human vital nervous organism. Parkinson's disease (PD) is a progressive neurological disorder commonly presented with tremors, slowness of movement, gait and balance issues. Additional problems could be speech, sensory disturbances, sleep issues, cognitive decline and psychological issues. Most of this will directly affect the day-to-day activities of individuals and result in reduced independence, which might lead to social isolation. It is a matter of sorrow that no specific clinical tests were introduced to detect Parkinson's disease correctly. As Parkinson's disease is non-communicable, early-stage detection of Parkinson's can prevent further damage in humans suffering from it.

# REFERENCES:

## [1] Early Identification of Parkinson's Disease from Handdrawn Images using Histogram of Oriented Gradients and Machine Learning Techniques.

### Authors:

- Ferdib-Al-Islam (Khulna University of Engineering & Technology, Khulna, Bangladesh)
- Laboni Akter (Khulna University of Engineering & Technology, Khulna, Bangladesh)

### Algorithms:

- Decision Tree, Gradient Boosting, K-Nearest Neighbor, Random Forest, and some other classification algorithms with the HOG feature descriptor algorithm were applied.

- The proposed strategy with Gradient Boosting and K-Nearest Neighbors accomplished better execution in accuracy, sensitivity, specificity and system design flexibility.
- Gradient Boosting algorithm got 86.67%, 93.33%, and 80.33% for accuracy, sensitivity, and specificity and KNN got 89.33%, and 91.67% for accuracy, and sensitivity respectively

## [2] Prediction of Parkinson's Disease using Machine Learning and Deep Transfer Learning from different Feature Sets.

## Authors:


- Supriya Kamoji (Fr. Conceicao Rodrigues College of Engineering, Mumbai, India )
- Dipali Koshti (Fr. Conceicao Rodrigues College of Engineering, Mumbai, India)
- Valiant Vincent Dmello (Fr. Conceicao Rodrigues College of Engineering, Mumbai, India)
- Alrich Agnel Kudel (Fr. Conceicao Rodrigues College of Engineering, Mumbai, India)
- Nash Rajesh Vaz (Fr. Conceicao Rodrigues College of Engineering, Mumbai, India).


## Algorithms:

- The Freezing of Gait dataset was used to predict if there were symptoms related to legs and trunk by analyzing the patient's gait, the Parkinson's Clinical speech dataset to detect a deviation in audio frequency and lastly the Parkinson's Disease wave and spiral drawing dataset which can help find out impairment in writing due to a tremor in hand or arm.
- The detection of impairment in handwriting seems to be the most convenient method and Convolutional Neural Network using Transfer Learning is implemented on this image dataset.

## [3] Parkinson's Disease Detection from Spiral and Wave Drawings using Convolutional Neural Networks: A MultiStage Classifier Approach.

## Authors:


- Sabyasachi Chakraborty (Department of Computer Engineering/Institute of Digital Anti-Aging Healthcare/uHARC, Inje University, South Korea)
- Satyabrata Aich(Department of Computer Engineering/Institute of Digital Anti-Aging Healthcare/u-HARC, Inje University, South Korea)
- Jong-Seong-Sim (Department of Computer Engineering/Institute of Digital Anti-Aging Healthcare/uHARC, Inje University, South Korea)
- EunyoungHan (Department of Neurology, Haeundae Paik Hospital, Inje University, South Korea)
- Jinse Park (Department of Neurology, Haeundae Paik Hospital, Inje University, South Korea)
- Hee-Cheol Kim (Department of Computer Engineering/Institute of Digital Anti-Aging Healthcare/uHARC, Inje University, South Korea).


## Algorithms:

- In this paper, a system design is proposed for analysing Spiral drawing patterns and wave drawing patterns in patients suffering from Parkinson's disease and healthy subjects.
- The system developed in the study leverages two different convolutional neural networks (CNN), for analyzing the drawing patterns of both spiral and wave sketches respectively.
- Further, the prediction probabilities are trained on a metal classifier based on ensemble voting to provide a weighted prediction from both the spiral and wave sketch. • The complete model was trained on the data of 55 patients and has achieved an overall accuracy of 93.3%, average recall of 94 %, average precision of 93.5% and average f1 score of 93.94%.

## [4] An Early Detection of Parkinson's Disease from Geometric Drawings.

## Authors:


- Vishal Nandan Medhi
- Kaustav Moni Basumatary

(Dept. of ECE, Bio-Medical Imaging Laboratory(BIOMIL), National Institute ofTechnology Silchar, Silchar, Assam, India).


## Algorithms:

- The methodology uses the Histogram of Oriented Gradients (HOG) as the feature descriptor and proposes the weighted Random Forest (WRF) classifier technique.
- HOG will track the intensity changes in the images, and the WRF works with a small dataset to provide effective results.
- This strategy provides a very good testing accuracy of 93% and 92% on the wave and spiral datasets. This method is a very robust and cost-effective method for the early detection of PD.

## [5] Parkinson's Disease Detection Using Voice and Spiral Drawing Dataset.

## Authors:


- Korakanchi Madhu Mohan Rao
- Mallavarapu Sai Naveen Reddy

(CSE Hindustan Institute of Technology and Science, Chennai, India).

## Algorithms:

The proposed system is a predictive model that uses the combination of voice data set and spiral drawing dataset and gives the intensity of Parkinson's disease for affected persons.

# TECHNICAL PUBLICATIONS:

## [1] Article 1:

Impaired Brain Information Transmission Efficiency and Flexibility in Parkinson's Disease and Rapid Eye Movement Sleep Behavior Disorder: Evidence from Functional Connectivity and Functional Dynamics

## Authors:


- Jing Wei,
- Jiaqi Lyu.


## Abstract:


Parkinson's disease (PD) is a common neurodegenerative disorder. Rapid eye movement sleep behaviour disorder (RBD) is one of the prodromal symptoms of PD. Studies have shown that brain information transmission is affected in PD patients. Consequently, we hypothesized that brain information transmission is impaired in RBD and PD. To prove our hypothesis, we performed functional connectivity (FC) and functional dynamics analysis of three aspects—based on the whole brain, within the resting-state network (RSN), and the interaction between RSNs—using normal control (NC) (n = 21), RBD (n = 24), and PD

(n = 45) resting-state functional magnetic resonance imaging (rs-fMRI) data sets.

## [2] Article 2:

The Anti-Inflammatory Effect of Preventive Intervention with Ketogenic Diet Mediated by the Histone Acetylation of mGluR5 Promotor Region in Rat Parkinson's Disease Model: A Dual-Tracer PET Study

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## Authors:


- ❖ Yuankai Zhu,
- ❖ Xiangyu Tang,


## Abstract:


The exact pathological mechanism of Parkinson's disease (PD) remains elusive, and the existing therapies fail to reverse the disease progression. This study intended to explore the epigenetic anti-inflammatory mechanism of the ketogenic diet (KD). Materials and Methods. The neuroprotective effect of the ketosis state before the onset of PD (preventive KD, KDp) was compared with that of receiving KD after the onset (therapeutic KD, KDt) in the lipopolysaccharide- (LPS-) induced rat PD model. A total of 100 rats were randomly assigned to the following 4 groups: sham, LPS, LPS + KDp, and LPS + KDt groups. Results. Significant dopamine deficient behaviours (rotational behaviour and contralateral forelimb akinesia), upregulation of proinflammatory mediators (TNF-α, IL-1β, and IL-6), loss of dopaminergic neurons, reduction of $mGluR5^{+}$ microglia cells, increase of $TSPO^{+}$ microglia cells, reduction of H3K9 acetylation in the mGluR5 promoter region and mGluR5 mRNA expression, and decline in the phosphorylation levels of Akt/GSK-3β/CREB pathway were observed after the intervention of LPS.

# RESEARCH PAPERS:

## Research Paper Name:

Parkinson's disease: etiopathogenesis and treatment

## Authors:


- Joseph Jankovic,
- Eng King Tan


## Abstract:


The concept of 'idiopathic' Parkinson's disease (PD) as a single entity has been challenged with the identification of several clinical subtypes, pathogenic genes and putative causative environmental agents. In addition to classic motor symptoms, non-motor manifestations (such as rapid eye movement sleep disorder, anosmia, constipation and depression) appear at the prodromic/premotor stage and evolve, along with cognitive impairment and dysautonomia, as the disease progresses, often dominating the advanced stages of the disease. The key molecular pathogenic mechanisms include α-synuclein misfolding and aggregation, mitochondrial dysfunction, impairment of protein clearance (associated with deficient ubiquitin-proteasome and autophagy-lysosomal systems), neuroinflammation and oxidative stress. The involvement of dopaminergic as well as noradrenergic, glutamatergic, serotonergic and adenosine pathways provide insights into the rich and variable clinical phenomenology associated with PD and the possibility of alternative therapeutic approaches beyond traditional dopamine replacement therapies.