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PARKINSONS DISEASE PREDICTION USING AI TECHNIQUES

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ABSTRACT

Parkinson's disease (PD) is one of the more common neurodegenerative disorders, with two stages of progression: normal and severe. With all of the shortcomings in clinical settings, identifying the stage of PD severity and predicting its progression course can be difficult. As a result, it appears that there is an increasing need to use supervised and unsupervised artificial intelligence and machine learning methods on clinical and paraclinical datasets to accurately diagnose Parkinson's disease, identify its stage, and predict its course. MRI-related data are regarded as useful in detecting various pathologies in the brain in today's neuro-medicine practises. Furthermore, the field has recently seen an increase in the use of deep learning methods in image processing, often with excellent results. In this study, we used Artificial Neural Networks (ANN) to develop a model for distinguishing different stages of Parkinson's disease. The results demonstrated that our current MRI-based CNN model could potentially be used as a suitable method for distinguishing PD stages with a high accuracy rate.

Keywords: Parkinson’s disease, Artificial Neural Network (ANN), MRI images, Convolutional Neural Network (CNN)

INTRODUCTION

Parkinson's disease (PD) is a neurodegenerative disease that primarily affects the elderly. PD affects nearly 1% of the global population [1, with many cases presenting with complex motor and cognitive issues. Cognitive and behavioural symptoms such as personality changes, depressive disorders, memory dysfunction, and emotion dysregulation may emerge as the disease progresses. Furthermore, as the disease progresses, movement symptoms worsen. Dementia should be diagnosed early so that appropriate therapeutic interventions can be implemented to prevent cognitive decline. [2]

In routine practise, clinicians diagnose Parkinson's disease based on the presenting symptoms, which include slowness, stiffness, tremor, and balance/coordination issues. However, such symptoms and their rates of progression may vary from case to case. There appears to be no specific blood test or biomarker to accurately diagnose Parkinson's disease or monitor underlying changes as the condition worsens. 1

Over the last three decades, MRI (magnetic resonance imaging) has been used to diagnose and distinguish various neurological diseases from suspected Parkinson's disease. [3]. The following are the study's contributions: I this model obtained reliable accuracy in terms of classification using only one feature extracted from the images. (ii) The sample size used was sufficient and diverse. (iii) Using image processing and artificial neural networks separately simplifies the application of this model in real-world situations, i.e., this approach requires very little processing power and has a high level of accuracy.

LITERATURE REVIEW

In this study [4,] we used the PubMed and IEEE Xplore databases to conduct a review of studies published up to February 14, 2020. There were a total of 209 studies included. These studies show that machine learning methods and novel biomarkers have a high potential for adaptation in clinical decision making, leading to more systematic, informed PD diagnosis.

Several datasets were researched, analysed, and run through specific algorithms in this paper [5] to detect several symptoms. The Freezing of Gait dataset was used to predict if the patient had symptoms related to the legs and trunk by analysing the patient's gait, the Parkinson Clinical Speech dataset to detect deviations in audio frequency, and finally the Parkinson Disease wave and spiral drawing dataset to detect impairment in writing due to a tremor in the hand or arm.

The authors used automated machine learning [6] to analyse multimodal data from the Parkinson's progression marker initiative (PPMI). Following the selection of the best performing algorithm, all PPMI data was used to tune the chosen model. The model was validated using data from the Parkinson's Disease Biomarker Program (PDBP). For the diagnosis of Parkinson's disease, our initial model had an area under the curve (AUC) of 89.72%. The refined model was then validated on external data (PDBP, AUC 85.03%).

The goal of this work [7] is to compare various machine learning models in successfully predicting the severity of Parkinson's disease and develop an effective and accurate model to help diagnose the disease accurately at an earlier stage, which could help doctors assist in the cure and recovery of PD patients. We intend to use the Parkinson's Tele monitoring dataset obtained from the UCIML repository for the aforementioned purpose.

III. PROPOSED METHODOLOGY

Deep learning was used to power the proposed methodology for predicting the severity of Parkinson's disease. The MRI data of Parkinson's disease patients were first collected, and the data was then pre-processed. Deep neural networks with an input layer, hidden layers, and an output layer were created next.

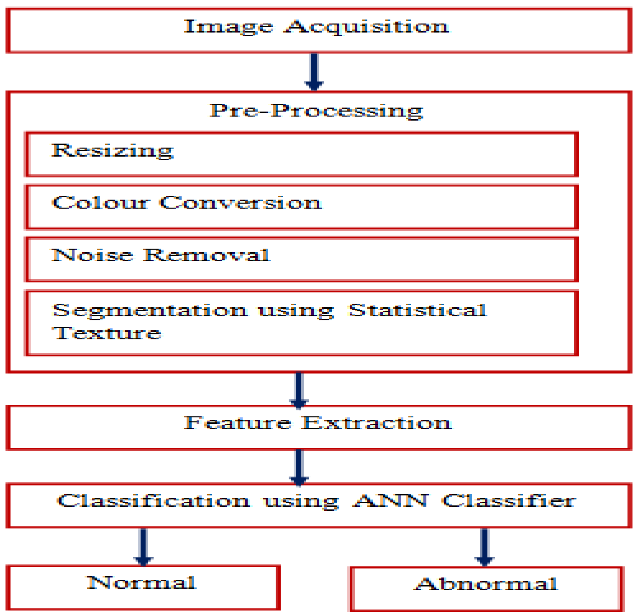

Fig.1. Proposed Architecture

Image Acquisition

Image Acquisition is the process of obtaining an input image for the automatic detection of normal and abnormal images using Digital Image Processing.

Pre Processing

At the most basic level of abstraction, both input and output are intensity images, which are referred to as pre-processing. The goal of pre-processing is to improve the image data by suppressing unwanted distortions or enhancing some image features that are important for subsequent processing.

Noise Removal Using Median Filter

The median filter [8] is a type of nonlinear digital filter that is commonly used to remove noise from an image or signal. Such noise reduction is a common pre-processing step used to improve the results of subsequent processing (for example, edge detection on an image). The median filter works by going through the signal entry by entry and replacing each entry with the median of neighbouring entries.

Segmentation

Image segmentation is the process of dividing a digital image into multiple segments in computer vision (sets of pixels, also known as super-pixels). The goal of image segmentation is to simplify and/or change an image's representation into something more meaningful and easier to analyse. Image segmentation is commonly used to find objects and boundaries (lines, curves, and so on) in images.

Fuzzy With PSO

The proposed method, FPSOFCM (Fuzzy Particle Swarm Optimization for FCM), employs the FPSO algorithm to determine the initial cluster centres of FCM based on a new fitness function that combines fuzzy cluster validity indices. Segmenting images is a critical task in image processing and computer vision applications.

It is the initial step in image processing and pattern recognition. Image segmentation is the process of dividing an image into many regions of pixels that correspond to different objects or parts of objects based on homogeneity criteria (for example, pixel intensity, colour, or texture) [2]. Because the performance of FCM is highly dependent on the initialization of cluster centres, where random selection in these centres causes the algorithm to easily fall into local optimal solution [8, 10].

Spatial information was incorporated into the membership function by the algorithm. Wensheng et al. [23] proposed a fuzzy PSO approach to image clustering. Each particle is treated as a candidate cluster centre in their method, and particles fly through the solution space looking for suitable cluster centres. Forghani et al. [11] used an Improved Fuzzy C-Means IFCM and PSO method to find optimal values for two influential factors in segmentation: the feature difference between neighbouring pixels in the image and their relative location. Chun and Fang [24] described a hybridised FCM-PSO image segmentation approach. The FCM algorithm is used to find cluster centres with the highest similarity function.

or PSO is used to assign each pixel to a cluster and minimises the dissimilarity function.

Zhou proposed an image segmentation algorithm based on the predator-prey (PPPSO) and FCM algorithms to address the shortcomings of the FCM algorithm, which is sensitive to initial cluster centres and easily traps into the local optimum. 2. Cluster validity indices and the FCM algorithm I

1: input: original image

2: Fix the parameters.

3: Create a swarm with p particles: initialize randomly X and V

4: Initialize randomly cluster centers Z (c _ p matrix)

5: best-global-fitness

7: for t 1 to itermax do

8: Calculate the cluster centers Z for each particle

9: Calculate the fitness value Fitness of each particle

10: Update the best global fitness best-global-fitness

11: Calculate pbest and gbest

12: Update the velocity matrix V for each particle

13: Limit the velocity to the range [□vmax;+vmax]

14: Update the position matrix X

15: Normalize the position matrix

16: if

___

best-global-fitnesss(t) □ best-global-fitnesss(t□1)

___

< " then

break
end if
end for
FCM
Initialize cluster centers
for t 1 to itermax do
Update the membership function
Update the cluster centers
Compute the objective function
if
J(t)□J(t+1)
< " then
break
end if
end for
return U the membership degrees of each pixel to c clusters
Defuzzyfication of the partition matrix U
output: segmented image

Fig.2. FPSOFCM Algorithm

Feature Extraction

Feature extraction in machine learning, pattern recognition, and image processing begins with an initial set of measured data and builds derived values (features) that are informative and non-redundant, facilitating subsequent learning and generalisation steps and, in some cases, leading to better human interpretations. Dimensionality reduction is related to feature extraction.

Classification Using ANN

An ANN is built from a network of connected units or nodes known as artificial neurons, which are loosely modelled after the neurons in the human brain. The signal at a connection between artificial neurons is a real number in common ANN implementations, and the output of each artificial neuron is computed by some non-linear function of the sum of its inputs. Edges are the connections between artificial neurons. The weight of artificial neurons and edges is typically adjusted as learning progresses. The weight changes the strength of the signal at a connection. Artificial neurons may have a threshold that is crossed by the aggregate signal before the signal is sent. Different layers may apply various transformations to their inputs. Signals travel from the first layer (the input layer) to the final layer (the output layer), possibly multiple times.

Computer vision, speech recognition, machine translation, social network filtering, games, and medical diagnosis have all made use of artificial neural networks.

ANNs are made up of multiple nodes that mimic biological neurons in the human brain. The neurons are linked together and interact with one another. The nodes can accept input data and perform basic operations on it. The outcome of these operations is communicated to other neurons. Each node's output is referred to as its activation or node value.

Each link has a weight associated with it. ANNs have the ability to learn by changing their weight values.

The diagram below depicts a simple ANN.

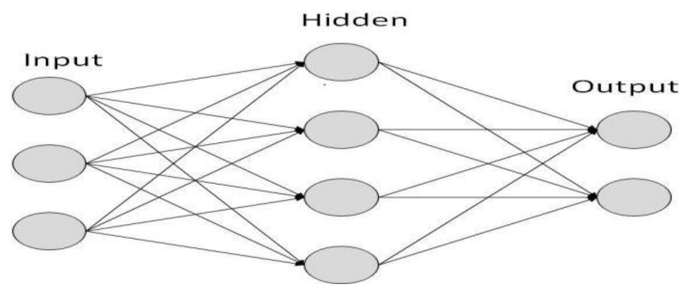

Fig.3. Artificial Neural Network (ANN)

IV. RESULT AND DISCUSSION

The below given are the outputs acuqired through this work. Through this application one can predict the given image is affected or normal person's image.. This work will reduce the workload of the physicians considerably.

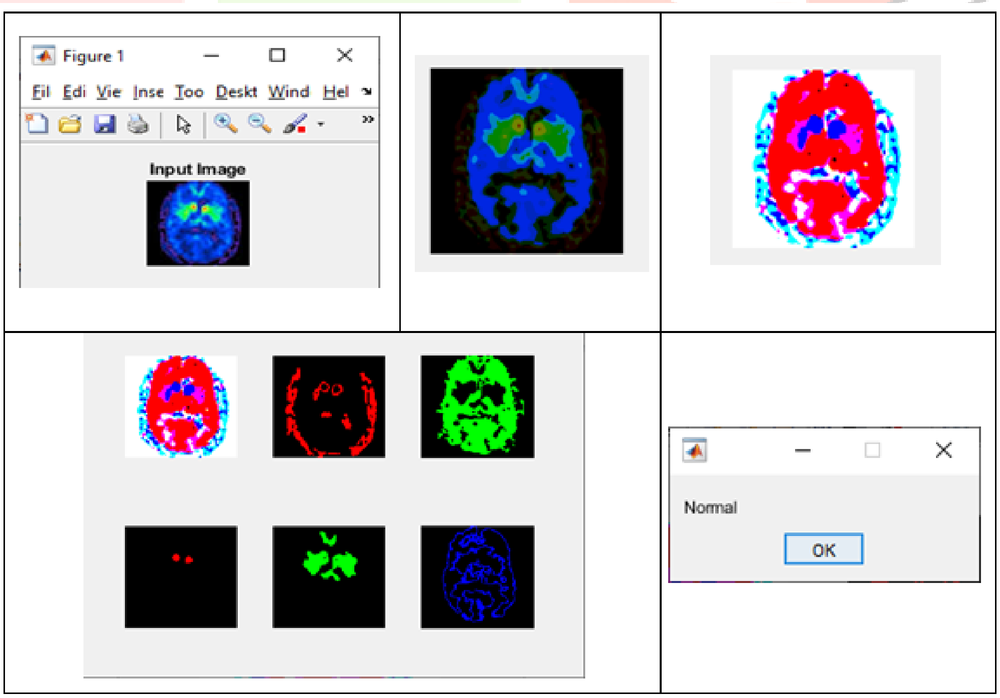

Fig.4. Different stages in Prediction, predicted as normal image

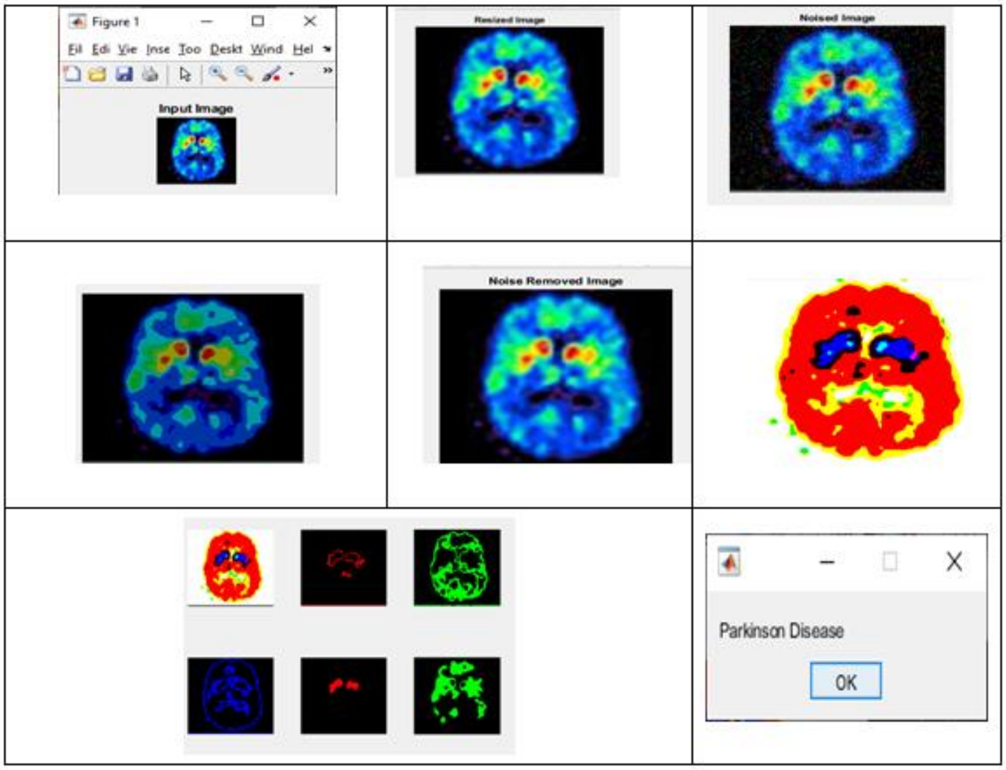

Fig.5. Different stages in Prediction, predicted as parkinson's disease image

CONCLUSION AND FUTURE SCOPE

The model presented in this paper approached the problem of detecting PD from a different perspective than previous approaches. The obtained results are very applicable to real-life situations. Developing usable software in this manner can help physicians detect Parkinson's disease with greater accuracy than previously. A model with more datasets can provide even higher accuracy. We were unable to compare our results and performance with actual clinicians/specialists in this preliminary work. In the future, the focus will be on other types of datasets, as well as increasing the size of the data to account for all possible diseases and obtain more accurate results.

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