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Early Detection of Parkinson Disease By Using Dense Convolutional Neural Network Algorithm

Pragadeesh S
Electrical and Electronics Engineering,
PSG Tech Coimbatore
Pdeesh367@gmail.com

Anju A Sanu
Biomedical Engineering
Rathinam Technical Campus
Coimbatore
Anjuasanu.ece@rathinam.in

Jisha Mathew
Electronics and Communication
Engineering, Rathinam Technical Campus, Coimbatore
Jishamathew55@gmail.com

Mohammed Vasif R
Electrical and Electronics Engineering
PSG Tech Coimbatore
Vasif 111@gmail.com

Abstract

One of the most prevalent neurodegenerative illnesses affecting adults over 65 is Parkinson's disease. Due to the progressive nature of this illness, patients would suffer greatly from serious health-related issues as well as increased healthcare costs if this condition was not diagnosed in its early stages and monitored at various points. Parkinson's disease is a type of neurological illness that is typically found in older adults. Approximately 1% of people worldwide have Parkinson's disease (PD), and many of these patients have complex movement and cognitive problems. Cognitive and behavioural symptoms, such as a wide range of personality changes, depressive disorders, memory problems, and emotion dysregulation, may appear as the condition progresses. Furthermore, when the illness worsens, so do the symptoms related to movement. Early dementia diagnosis is important in order to apply suitable therapeutic strategies to stop cognitive decline. PD is often diagnosed by clinicians based on the presenting symptoms, which include stiffness, tremor, slowness, and issues with balance and coordination. However, each instance may have different symptoms and a different rate of advancement. As of right now, it appears that there is no particular blood test or biomarker to reliably identify Parkinson's disease (PD) or track underlying changes as the illness progresses. Magnetic resonance imaging, or MRI, has been utilized for the past thirty years to distinguish between different neurological conditions and probable Parkinson's disease. Numerous studies have demonstrated that current state-of-the-art CNNs maintain accuracy comparable to human ability. Furthermore, one of the most crucial elements in medical image processing has been feature representation. Conventional machine learning techniques would not take into account new and hidden features that are extracted and used by deep learning techniques like CNN. In order to evaluate the severity of the Parkinson's disease at different stages and between the healthy patient groups, an automated system that has been trained using features extracted from the various mri performed by both PD patients and the healthy group of patients has been developed in this project. The analysis was out in this study to separate the PD patients from the healthy volunteers based on the MRI by taking elements out of the drawings that the PD and healthy patients made of theit bodies.

Keywords: Convolutional neural network (CNN); Dense convolutional neural network (DCNN); Parkinson disease (PD)classification; Magnetic resonance imaging (MRI); Neuro imaging (NI).

1. INTRODUCTION

Parkinson's disease is a degenerative neurological condition affecting the nervous system and the body's nerve-controlled regions. The onset of symptoms is gradual. A tremor in one hand that is hardly perceptible may be the initial symptom. Although tremors are prevalent, the disease can also make you stiff or move more slowly. You may have little to no expression on your face in the early stages of Parkinson's disease. As you walk, your arms might not swing freely. You can start to speak more slowly or slurred. As your Parkinson's disease worsens over time, so do its symptoms. While there is no known cure for Parkinson's disease, taking medication may greatly lessen your symptoms. Your doctor may occasionally recommend surgery to treat your symptoms by regulating certain brain regions. For this project, we will gather 1125 MRI scan images of healthy individuals and compare them to those of Parkinson to determine whether these traits can distinguish between the two groups of persons.

2. II.LITERATURE REVIEW

Zaman, Nabila (2020) The condition known as presented Parkinson's disease (PD) is characterised by a lack of motor coordination, tremor, shaking, or giddiness, sadness, or both. It is a disorder identified based on behaviour. In order to diagnose Parkinson's disease (PD), physicians consider a patient's blood pressure and behaviour. It seems that most people wait until it is too late to receive a correct Parkinson's diagnosis. In order for the author to guarantee that PD patients receive the right care and support to enable them to realise their full potential, it is critical to detect Parkinson's disease (PD) as early as possible by screening and monitoring. Thus, without the assistance of a specialist, the authors created a method that can diagnose Parkinson's disease and reach a trustworthy and useful result. The creators anticipate that this approach will be very beneficial to experts as well as to those who are worried about their Parkinson's disease [1].

Yukthi (2019) expounded on Parkinson's disease (PD) is a medical illness that severely impairs a person's neurology. Parkinson's disease is typically identified by MRI brain scans, which reveal swallowing difficulties and tremors in the affected person. But it turns out that this is very costly and time-consuming. According to recent research, facial image analysis can be used to identify Parkinson's disease. Deep learning models are pre-trained in this work to identify between healthy and Parkinson's disease based on facial image classification. The arrangement of features in a Parkinson2019s image, such as the nose, eyes, and lip distance, can be a sign of the disease. In contrast to earlier techniques for PD detection, the suggested method carries out thorough pre-processing by eliminating duplicate images, therefore, making it appropriate for practical uses. The Mobile Net model achieved a maximum testing accuracy of 87% on face image training [2].

According to Anshu Sharma (2020), Parkinson's disease (PD) is a complex, multifaceted, and lifelong developmental impairment that involves issues with trembling, giddiness, and despair. Parkinson's disease has been growing more rapidly in recent years, necessitating an early diagnosis. Parkinson's disease detection with different screening tools takes a lot of time and money. Predictive analytics, a term used to refer to a variety of mathematical models, has been increasingly popular in recent years. Machine learning and pattern recognition are two examples of transdisciplinary medical research fields that offer efficient methods for Parkinson's disease diagnosis. The purpose of the author's study is to examine different machine learning methods, such as logistic regression, Random Forest Scan, SVM (support vector machine), and decision trees, and compare the outcomes based on their accuracy and efficiency [3].

Megha George (2017) Exhibited According to a WHO report, one in every 160 persons worldwide suffers with Parkinson's disease; in India, that number is estimated to be one in 500. Early detection during their formative years would be extremely beneficial to them, however Parkinson's disease is often overlooked and misdiagnosed. Therefore, creating a detection model that depends on interactions between anatomical or functional brain regions—like Parkinson's disease—is essential for diagnosis. This helps physicians diagnose by enabling them to look at the past and behaviour of the PD-affected person. Here, the main goal is to list the many PD detection techniques that are already in use and compare and contrast them in order to generate preliminary theories that can be verified through appropriate investigation. In this work, A comparison of the most recent techniques found in the literature was provided by the author. Additionally, this publication addressed research potential related to Parkinson disease as well as numerous problems associated with PD [4].

In 2020, Ravi Exhibited A complex neurodegenerative condition affecting the body's central nervous system is Parkinson's disease (PD). In benchmarking tests, CNN's superior performance in resolving crucial image classification issues has outperformed human skill in applications like traffic sign detection. However, because of the considerable visual variety within a class and the high similarity between classes, achieving high

classification accuracy is difficult. The CNN model's parameter count was lowered in this study using a single convolutional layer design to prevent over-fitting. The difficulties with feature selection and reduction in picture classification are discussed in the publication "Classification of Alzheimer's Disease Using MRI Data and Deep Learning Convolutional Neural Networks." The difficulties in choosing the most discriminative features needed to construct the classification model are illustrated in this paper. This study discusses a few CNN designs that were effective in differentiating between Alzheimer's patients' functional MRI data and those of healthy control participants [5].

3. PROPOSED METHOLOGY FOR PARKINSON DISEASE DETECTION

A.BLOCK DIAGRAM

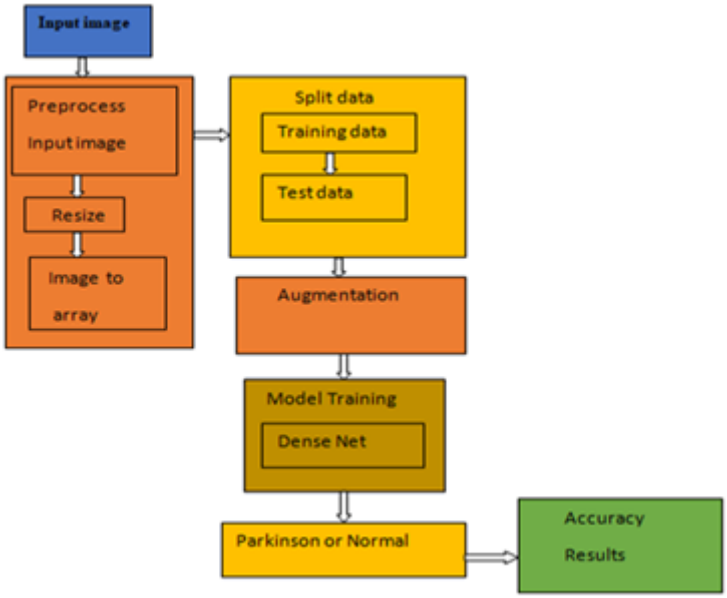

Fig3.1 Block diagram

B. DATABASE

Get the 1125 Peoples Scanned Magnetic Resonance Imaging dataset from the Parkinson Kaggle website. This dataset includes both healthy and Parkinson disease-afflicted individuals.

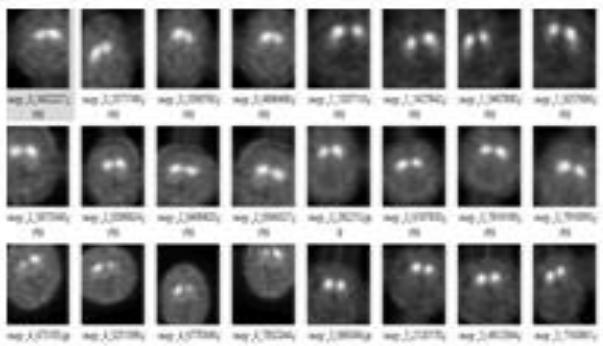

Fig 1.Parkinson disease MRI dataset

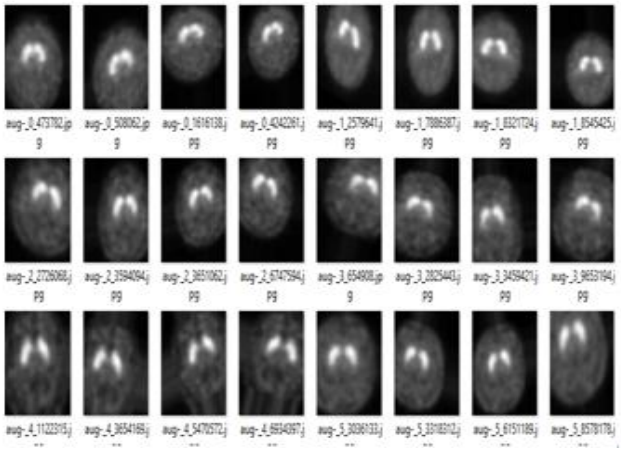

Fig 2. Normal disease MRI datase

C. PREPROCESSING TECHNIQUES:

A. IMAGE PREPROCESSING AND LABELLING:

1125 Imaging via Magnetic Resonance The downloaded scanned images from the Parkinson Kaggle came in a variety of formats, each with its unique resolution and quality. Final photos meant to be utilised as a dataset for a deep neural network classifier were preprocessed to gain consistency and improve feature extraction. In order to emphasise the region of interest, all of the photos were manually cropped as part of the preprocessing method.

B. CONVERTING IMAGE TO ARRAY:

```
def convert_image_to_array(image_dir):
    try:
        image = cv2.imread(image_dir)
        if image is not None:
            image = cv2.resize(image, DEFAULT_IMAGE_SIZE)
            return img_to_array(image)
        else:
            return np.array([])
    except Exception as e:
        print(f"Error : {e}")
        return None
```

Fig 3. Converting image to array

C. AUGMENTATION PROCESS

Augmentation is mostly used to expand the dataset and add a small amount of distortion to the images, which helps minimise overfitting in the training phase. By producing altered replicas of the photos in the dataset, a technique known as image data augmentation can be used to fictitiously increase the size of a training dataset. More data can be used to train deep learning neural network models, which can provide more sophisticated models. Additionally, augmentation techniques can produce different picture versions, which can enhance the fit models' capacity to apply what they have learnt to new images.

```
augment = ImageDataGenerator(rotation_range=25, width_shift_range=0.1,
                             height_shift_range=0.1, shear_range=0.2,
                             zoom_range=0.2, horizontal_flip=True,
                             fill_mode="nearest")
```

Fig 4. Augmentation process

D. SPLITTING DATA

To make sure the model performs effectively when applied to previously unknown data, divide the dataset into training (875 images) and testing (275 images). Having a validation set is crucial for tracking the model's performance during training and making any modifications.

E. TRAINING

By feeding batches of previously processed pictures into the network and back propagating the error, the (875images) DCNN may be trained with the training dataset. The objective is to minimise the loss function that exists between the true label and the expected output.

F. TESTING

After that, the data is sent to the dense layer, which uses it to identify any noteworthy dependencies in the temporal

features. With an accuracy rate of 85%, misclassification rate of 14.1%, true positive rate of 92.6%, false positive rate of 18%, true negative rate of 81.30%, false positive rate of 19.7%, precision rate of 92%, and prevalence rate of 59.0%, the suggested dense convolutional neural network performs well.

IV RESULTS AND DISCUSSIONS

A. NORMAL MRI BRAIN SCAN IMAGE

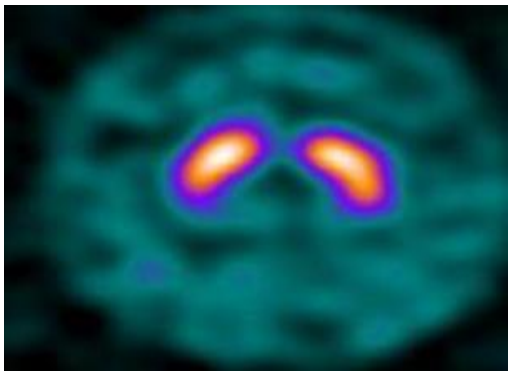

Fig 4. Normal MRI brain scan image

There are no anomalous focal regions of changed signal intensity in the brainstem, cerebellum, or cerebral hemispheres in this normal magnetic resonance imaging. The brain parenchyma's appearance and intensity are normal. Cisterns and the Ventricular System seem normal. There is no discernible vascular abnormalities or cerebral space-occupying lesion. No changes have been made to the midline structures.

B. PARKINSON DISEASE MRI BRAIN SCAN IMAGE

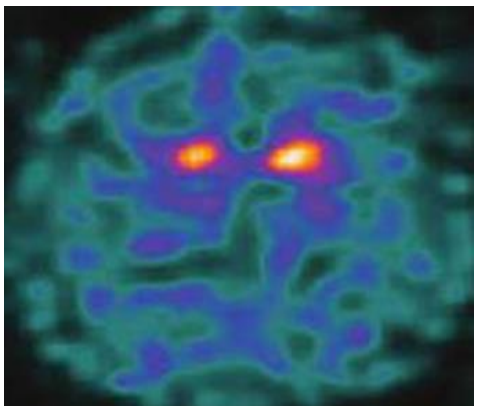

Fig 5. Parkinson disease MRI brain scan image

There are no anomalous focal regions of changed signal intensity in the brainstem, cerebellum, or cerebral hemispheres in this normal magnetic resonance imaging. The brain parenchyma's appearance and intensity are normal. Cisterns and the Ventricular System seem normal. There is no discernible vascular abnormalities or cerebral space-occupying lesion. No changes have been made to the midline structures.

C. CONFUSION MATRIX:

Matrix of Confusion in Machine Learning The performance of the classification models for a certain set of test data is evaluated using a matrix called the confusion matrix. Only after the true values of the test data are known can it be determined. Although the matrix itself is simple to understand, some of the terminology used in connection with it might be.

Fig 6. Confusion matrix diagram

D.TOTAL ACCURACY CALCULATION

Classifier	TP	TN	FP	FN	Misclassification	Precision	Prevelance	Accuracy
DenseConvolutional Neural network	92.6	81.3	18	19	14.1	92	59	85

Fig 7. Total Accuracy Calculation

E. RECAP OF THE WORK COMPLETED

For this project, we will gather 1125 MRI scan images of healthy individuals and compare them to Parkinson's patients to determine whether these traits can distinguish between the two groups of people. With an accuracy rate of 85%, misclassification rate of 14.1%, true positive rate of 92.6%, false positive rate of 18%, true negative rate of 81.30%, precision rate of 92%, and prevalence rate of 59.0%, the suggested dense convolutional neural network performs well.

F. NEW WORK TO BE DONE

To attain the highest level of accuracy possible in the detection of Parkinson disease, Dense Convolutional neural networks with deep learning networks are used. These algorithms can also be used to forecast various illnesses like autism, kidney failure, cardiac arrest, retinopathy, and so on. The goal of high level dopamine medication development is to stop the symptoms of Parkinson's disease by addressing its fundamental cause.

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