Parkinson's Disease Detection Using Transfer Learning

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Abstract: Parkinson's disease (PD) is an incurable neurological disorder disease. But there is no still no standard medical provision to identify Parkinson's disease. In this study, a fine motor symptom that is sketching has been studied. The experiments are done on a significant number of PD patients and healthy group (Without PD). We proposed a system that can determine the sketching and report whether a PD patient's sketch or not. Deep learning algorithms can deal with the solution of different brain generalizing neural networks with the same design. Thus we applied Transfer Learning to classify sketched images to discriminate or identify Parkinson's Disease (PD) affected patients from the regular healthy group. The experiment was done on different convolutional models with transfer learning method and applying on spiral and wave sketched data. By using Inception v3 and Resnet50 model with spiral sketching and wave sketching, the accuracy is more for the Inception v3. We have used the transfer learning which enhanced the model performance.

Keywords: Parkinson's disease, Deep learning, Convolutional Neural Network, Transfer Learning

I. INTRODUCTION

In this era, more than seven million people worldwide are affected by Parkinson's disease (PD), according to a recent study. Nowadays, this incurable disease is increasing tremendously. This disease gets its name from James Parkinson, who earlier described it as a paralysis agitans and later gave his surname was known as a PD. Parkinson's disease causes a diverse set of symptoms ranging from tremor to cognitive impairment, hallucination, dementia, sleep disorders, etc. It is the most common neurodegenerative disease among aged people who are more than 50 years old.

Till now, there is no complete cure. This paper aims the predict Parkinson's disorder. To avoid the significant negative impact on PD patients, identification of PD in the premier stage is mandatory.

Previous clinicians and researchers already used Handwriting and Spiral sketching to identify PD patients successfully in the premier stages. Spiral and wave sketching, and handwriting could be easily differentiated from healthy person (without PD) to a person affected by PD and the measurement of those sketching & handwriting are non-invasive. Parkinson's disease symptoms are broadly divided into two groups. One is Motor symptoms another one is Non motor symptoms. Motor symptoms are tremor (involuntary movement of the legs/ hands), stiffness (difficulty in moving the parts of the body), slowness in daily activities, impaired balance, shuffling gait. On the other hand, non-motor symptoms are difficulties with memory, slowness of thought, anxiety and depression, insomnia and fatigue, vision problem, hallucinations and delusions, speech and swallowing problems.

II. Methodology

Data Collection: We collected data from Kaggle's dataset. This dataset is a set of spiral and wave sketches from 55 subjects where 28 subjects from the healthy control group (without PD) and 27 subjects from the Parkinson's group. The dataset contains 102 spiral sketching images and 102 wave sketching images. A tablet, A3 size paper, and a pen were used to record sketching. Sample Images of the sketches for Healthy (without PD) and Parkinson Group.

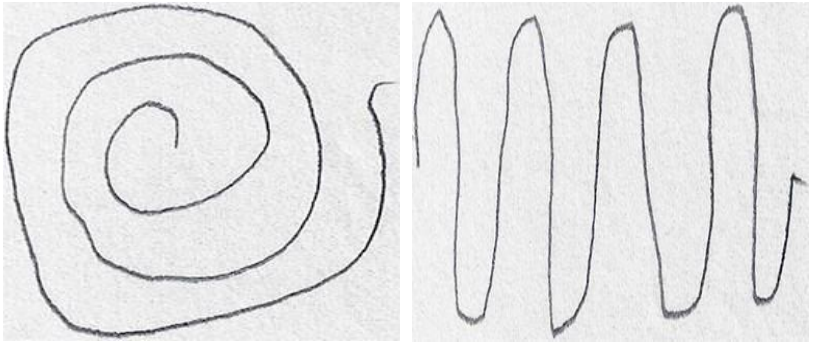

Fig. 1. (a) Healthy Spiral and Wave

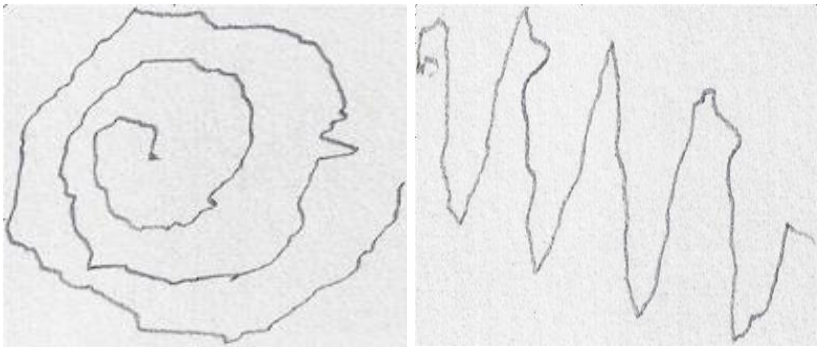

Fig. 1. (b) Parkinson Spiral and Wave

Inception V3: The inception V3 is a deep learning model on Convolution Neural Networks, which is used for image classification. The inception V3 is a superior version of the basic model Inception V1 which was introduced as Google Net in 2014. The inception V3 model was released in the year 2015, it has a total of 42 layers and 16,000 parameters.

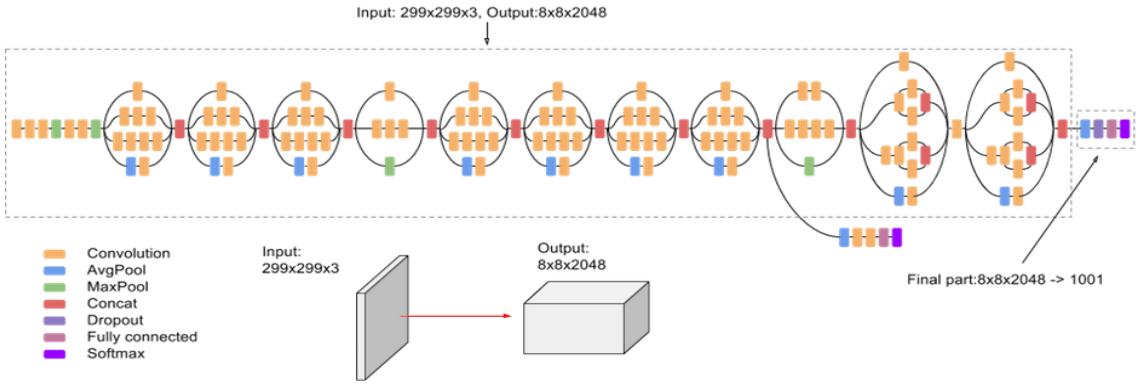

Fig. 2. Inception V3 Architecture

ResNet50: ResNet50 has 50 layers with 25 million parameters. In 2015, ResNet was the winner of the ImageNet challenge. It can train extremely deep neural networks successfully. Residual learning tries to learn some residual instead of trying to learn some features. ResNet used shortcut connections and created a residual block. The residual intermediate block learns how to adapt with input for high quality features. ResNet is introducing a "identity shortcut connection" which skips one or more layers. ResNet 50 architecture with two types of blocks; one is Convolutional block, and another one is identity block.

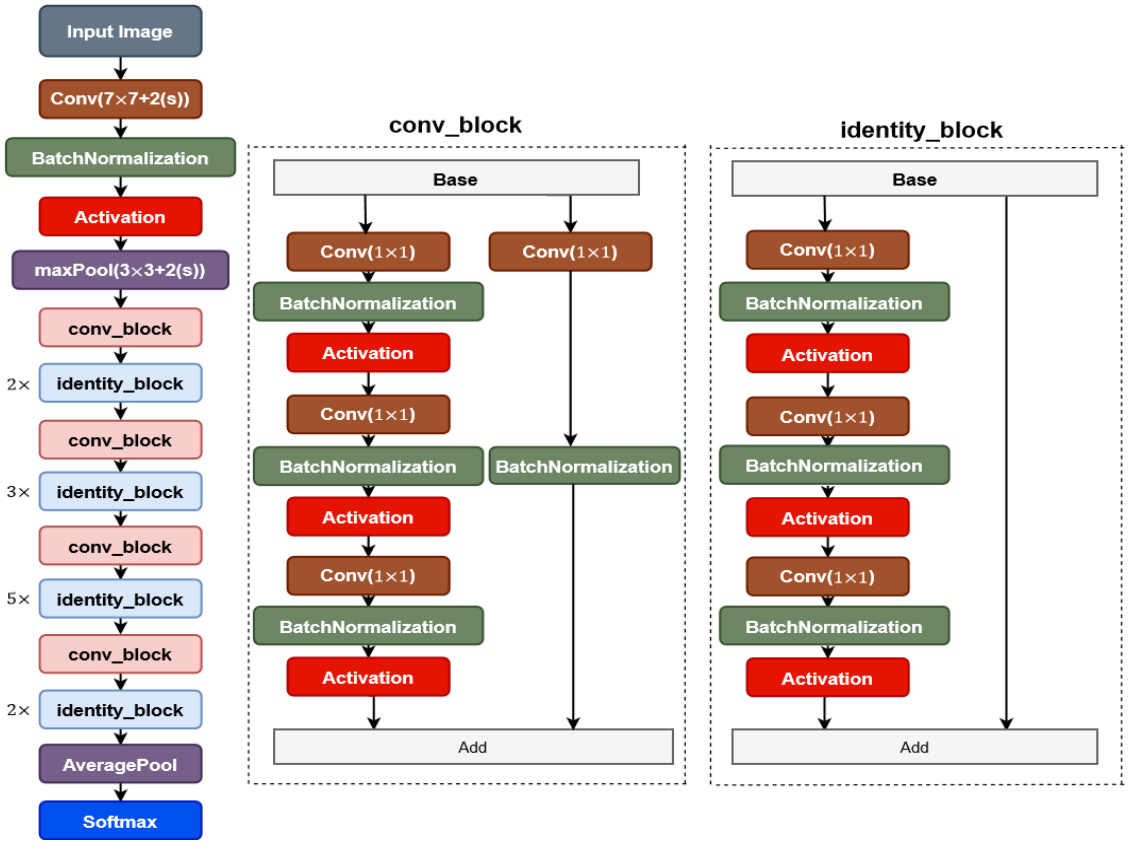

Fig. 3. ResNet50 Architecture

Transfer Learning: Transfer learning is a well-known and prominent technique that can use as a pre-trained model. When a model was trained with large-size benchmark datasets (e.g., ImageNet dataset) to solve a problem then it's called a pretrained model. Transferring knowledge of old tasks into a new job, when a new job is learned it is called transfer learning. We can reuse a model for different tasks by using transfer learning.

III. CONCLUSION AND FUTURE SCOPE

In this research, a system is developed to classify whether a person who attempted the sketching test is affected by Parkinson's disease or not based on Transfer Learning architecture. The work mostly took advantage of spiral and wave image data performed by healthy subjects and Parkinson's patients forclassification purposes. This research proposed here transfer learning with Inception V3 and ResNet50 architecture. The approach that has been applied: Inception V3 model provides satisfactory result with 92.83% accuracy to distinguish the sketches made by healthy subjects and Parkinson's patients using transfer learning. We will further improve the methodology and the performance of the classifier in this research. Though this study depends on built-in CNN architecture, there has a broad scope in the future to propose a new model using transfer learning. Also, improvement can be done on datasets with a wide variety of features that could play an important role to detect the disease.

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