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DIABETIC RETINOPATHY DETECTION USING CNN

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Abstract – *Diabetic Retinopathy (DR) is a condition which damages the retina of human eyes. This condition can lead to the blindness if left untreated. Early blindness due to Diabetic Retinopathy can be preventable with routine checkup is effective management of the underlying diabetes. Even though retinal surgeries are available to relieve the disease, far better is to early detection and prevention. Most of the works in this field are disease detection or manual extraction. Here in this paper, the automatic diagnosis of the disease into its different stages using CNN. It presents the design & implemented GPU accelerated Convolutional Neural Networks to automatically diagnosis and thereby classify-high resolution retinal images into 5 stages of disease based on severity.*

Key Words: Diabetic retinopathy, CNN

1. INTRODUCTION

Diabetic Retinopathy (DR) is a disease which damages the blood vessels in the Retina of human eyes when the blood sugar levels increases. These blood vessels can swell and leak. Or they can lose, stopping blood from passing through. Sometimes abnormal new blood vessels grow on the Retina. All of these changes can steal your vision. When the Diabetic Retinopathy (DR) gets worse, the symptoms such as seeing an increasing number of floaters, having blurry vision; poor night vision etc will be there. Diabetic Retinopathy (DR) can be diagnosed into 5 stages: mild, moderate, severe, Proliferative and no disease.

Diabetic Retinopathy (DR) is challenging because by the human readers submit their reviews, often a day or two later, the delayed results lead to lost follow up, miscommunication, and delayed treatment. Detecting DR is a time-consuming and manual process that requires a trained clinician to examine and evaluate digital color fundus photographs of retina. Clinicians can identify DR by the presence of lesions associated with the vascular abnormalities caused by the disease. While this approach is effective, its resource demands are high. The expertise and equipment required are often lacking areas where the rate of diabetes in local population is high and DR detection is most needed. As the number of individuals with diabetes continues to grow the infrastructure needed to prevent blindness due to DR will become even more insufficient. The paper aims at proposing a diabetic retinopathy diagnosis model that automatically learns features which are pivotal in diagnosing the stage of the disease without explicit or manual extraction.

Fig-1: Normal vision

Fig-2: DR Vision

In deep learning, a Convolutional Neural Network is a class of deep neural network most commonly supplied to analyzing visual imagery. They were inspired by biological processes in that the connectivity pattern between neurons. It consists of an input and an output layer, as well as multiple hidden layers. When programming a CNN. The input is a tensor with the shape (number of images) x (image height) x (image depth). Then after passing through a Convolutional layer, the image becomes abstracted to a feature map. with shape abstracted. The architecture of a CNN is designed to take advantage of the 2D hierarchical structure of an input image. Another benefit of CNNs is that they are easier to train and have many fewer parameters than fully connected networks with same number of hidden units.

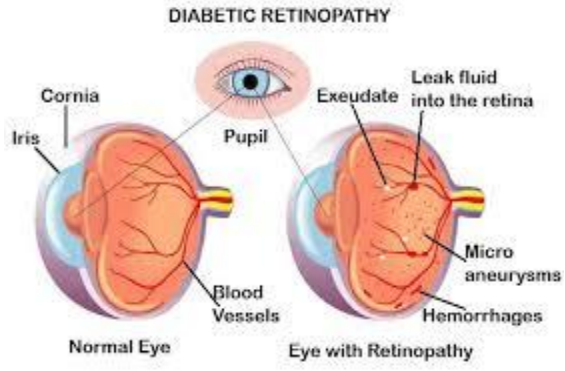

Fig-3: Structure of Normal eye and DR eye

2. THE DATASET

The dataset consist of high resolution color fundus retinal images belonging to fine corresponding to five stages of diseases. The images in the dataset come from different models and types of cameras, which can affect the visual appearance of left and right retinas. There is also noise in both the images and labels. Images may contain artifacts, be out of focus, underexposed or overexposed and are of different resolution.

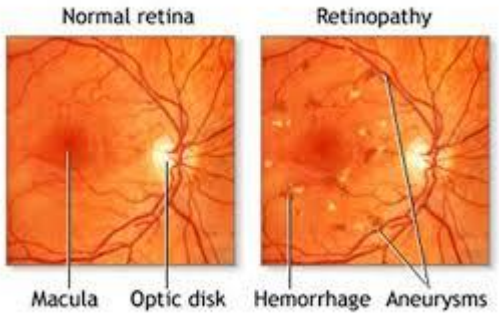

Fig -4: Retinal Fundus Images

3. DATA PRE-PROCESSING

Due to non-standard image resolutions, the training images could not be utilized directly for training. The images were scaled down to a fixed resolution size of 512x512 pixels to form a standardized dataset. Training images of resolution 512x512 pixels on all three color channels demanded high memory requirements. Due to this limitation, the images were converted to a single channel. After several experiments, it was found that green channel images retained information better than the other channel images. In order to prevent the Convolutional neural network from learning the inherent background noise in the image, each image was normalized using Min-Max normalization.

4. THE CNN ARCHITECTURE

The network contains an input layer which takes images with resolution 512x512 pixels as input. The architecture consists of 5 sets of combination of convolution, pooling and dropout layers, each stacked one over the other. This is followed by 2 sets of fully connected hidden and feature pooling layers. This is followed by the final output layer.

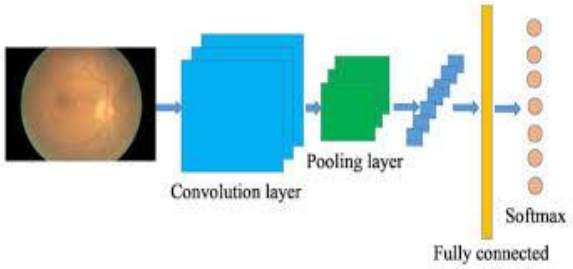

Fig -5: Layered Structure of CNN

In the architectures, one Convolutional layer is stacked over another without spatial pooling between them. The first Convolutional layer consists of 16 filters, each of the size 5x5. Each filter convolves over the input image. The third Convolutional layer consists of 32 filters, each of size3x3.Eachfilterconvolvesovertheoutputoftheprevious layer. Each pooling layer utilized max-pooling with filter of size 2x2. The max-pooling layer will perform a MAX operation which takes the maximum over the 2x2 region in the depth slice of the input. The role of dropouts in preventing a large network from overfitting and providing performance improvements of neural networks in supervised learning tasks

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5. SOFTWARE REQUIREMENTS

5.1 Opencv

Python is a library of Python bindings designed to solve computer vision problems. OpenCV-Python makes use of Numpy, which is a highly optimized library for numerical operations with MATLAB-style syntax. All the OpenCV array structures are converted to and from Numpy arrays. OpenCV is used for all sorts of image and video analysis, like facial

recognition and detection, license plate reading, photo editing, advanced robotic vision, optical character recognition, and a whole lot more. We will be working through many Python examples here.

5.2 SQLyog

SQLyog is a GUI tool for the RDBMS MySQL. It is developed by Webyog, Inc., based in Bangalore, India, and Santa Clara, California. Nowadays SQLyog is distributed both as free software as well as several paid, proprietary, versions. The free software version is known as Community Edition. It provides Intelligent Code Completion, Visual Schema Designer, Visual Query Builder, Query Formatter etc.

5.3 NetBeans

NetBeans is a world class platform for creating applications. Originally, it was a Java IDE. With each release, NetBeans is becoming more versatile. The newiest NetBeans 6.5 release has a new module for creating PHP applications. Ruby and C/C++ development modules were added in the past. NetBeans has recently released an Early Access IDE for the Python programming language. Fully functional Python IDE has been an old request or dream of many Python programmers. This NetBeans subproject seems very promising. Currently the project is under development. It has been released as a early access project. NetBeans has recently released an Early Access IDE for the Python programming language. Fully functional Python IDE has been an old request or dream of many Python programmers. This NetBeans subproject seems very promising. Currently the project is under development. It has been released as a early access project.

CONCLUSION

This paper presents the design, architecture and implementation of deep Convolutional neural networks for automatic detection and classification of diabetic retinopathy from color fundus retinal images. This research involves three major CNN models, designing their architectures. DR has many advantages over Fine tuning the current network parameters to obtain a greater accuracy on single channel images. Using all the channels instead of a single channel enabling the network to learn more features thereby decreasing over-fitting through increasing complexity of data. Working with alternate image pre-processing techniques to improve noise reduction.

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