Early Detection Of Cardio Vascular Disease From The Fundus Images Of The Retina Using Convolutional Neural Network

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Abstract –
The Retina is exclusive in your body in permitting simple perception of veins with non-intrusive instruments. It is additionally the main available site for considering the focal sensory system. Changes to the retina may appear in a few chronic disease's prior years different signs evident. Therefore, considering the retina may give an extra way to delineate hazard and help distinguish individuals who reap the benefits of early lifestyle changes and preventive therapies. This paper attempts to use image processing ways to study the human retina for early detection of cardio vascular disease using convolution neural network with a prediction accuracy of 0.94.

Keywords—retina, cardiovascular, arteriolar narrowing, CNN, deep learning

1. INTRODUCTION

Cardio vascular diseases are caused due to the abnormal increase in blood pressure which causes damage in the eye retina leads to hypertensive retinopathy. The hyper tensive characteristics occurs due to the narrowing arteries in retina and notching of veins. In some cases, due to occurrence of micro aneurysms and self-exudates, cardiovascular diseases will occur. Due to the changes in the width of the blood vessels one can identify the type of disease. The width of the vessel can be estimated from the arteriovenal ratio that will predict the cardiovascular disease.[1}.Canny edge detection technique is used to extract the micro aneurysms so that the cardiovascular disease is easily predicted with an accuracy of 88.5%[2].Blood vessel information can be located by the optic disc which is the vigorous part of the eye. The technique named ellipse fitting is used to locate the optical disc cup boundary so that cardio vascular diseases can be easily diagonized[3].Cardio vascular disease is detected by extracting the vascular tree and then it is segmented to extract the features and the extracted features can be trained using Artificial Neural Network classifier[4]

2. METHODOLOGY

The block diagram of proposed methodology is shown in the Fig.1. The input image is acquired by image acquisition and then it is preprocessed to remove the unwanted noises in the fundus image. The preprocessed image is segmented by using Otsu method and then it is fed to Convolution neural network to extract the features and to classify the diseased image or healthy image.

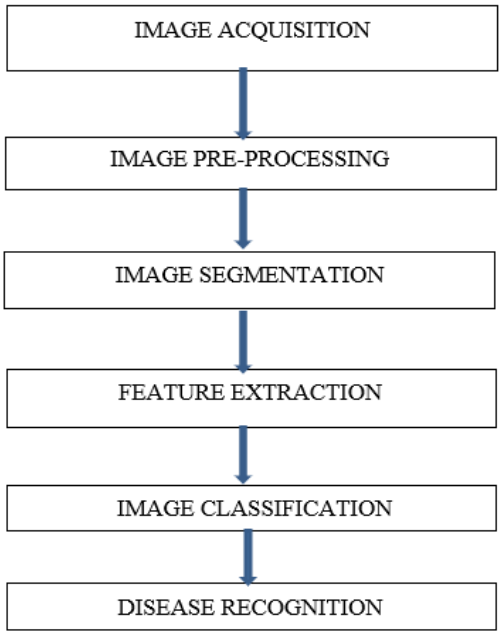
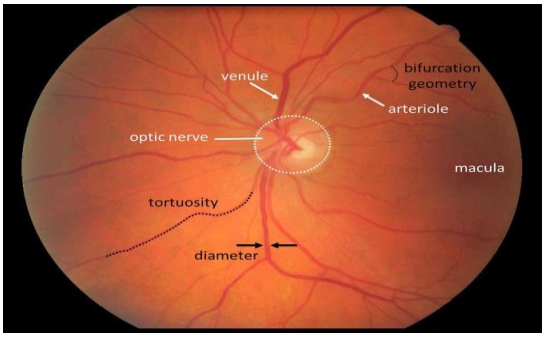


Fig.1.Block Diagram



The fundus image of the retina is shown in Fig.2.

A. **Image Acquisition and Pre-Processing**

Digital image acquisition is the displaying of a carefully encoded depiction of the visual characteristics of an object, for instance, a physical scene or the internal structure of an object. The term is regularly expected to incorporate processing, compression, storing, printing, and show of such pictures. [4]. The purpose of pre-processing is an improvement of the picture data that smothers unfortunate bends or overhauls some image features huge for extra dealing with. Pre-preparing is a run of the mill name for errands with pictures at the most decreased level of deliberation.[5]. The Acquitted and preprocessed image is shown in Fig.3. and Fig.4

Fig.3. Acquired image of the retina.

Fig.4.Preprocessed image

B.Image Segmentation

Morphological Segmentation is an Image module that consolidates morphological tasks, for instance, expanded minima and morphological slope, with watershed flooding calculations to section grayscale pictures of any kind in 2D and 3D. In picture handling, Otsu's technique is utilized to perform spontaneous image thresholding.

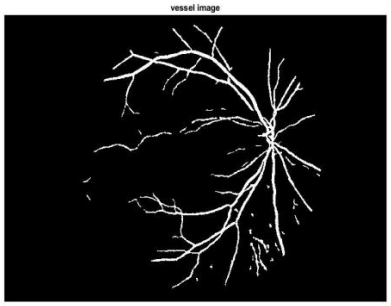


Fig.5: Segmented image of the retina.

The segmented Image is depicted in Fig.5.In the easiest structure, the calculation restores a solitary power edge that different pixels into two classes namely foreground and background This task utilizes this present Otsu's technique for segmentation of images [6].

C.Feature Extraction

The function of the feature extraction technique is to modify the original features in to most significant features. Feature extraction can be determined with dimensionality diminution. It will reduce the complexity of the images. Also, it will represent the image in the simplest form. It will extract only the pertinent information about the image from the noisy image so that information content is more and the redundancy of the image is minimized is shown in Fig.6.The accuracy of classification algorithm is based on the feature extraction technique. This paper utilizes Convolution Neural Networking for Feature extraction. [9]

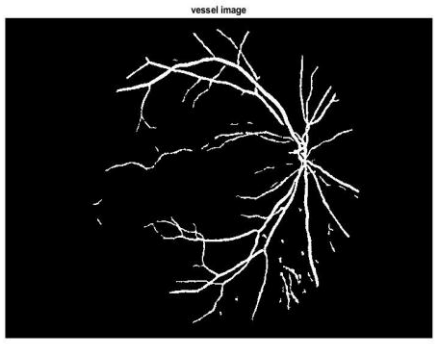


Fig.6.Feature Extraction

D. Image Classification

Classification incorporates a broad scope of preference hypothetical ways to handle the distinguishing proof images. All classification calculations depend on the presumption that the picture being described portrays at least one highlights and that each among these highlights offers a place with one of a few particular and restrictive classes. The classes could be determined from the previously by an examiner or consequently grouped into sets of model classes, where the investigator just indicates the quantity of wanted classifications.

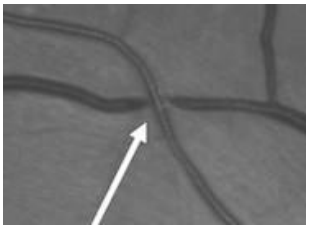


Fig.7.Arteriovenous nicking

Image classification scrutinize the statistical properties of different picture includes and find out the information into classifications. Classification calculations normally make use of two periods of processing: training and testing. In the underlying training stage, trademark properties of image features are segregated and, in view of these, an interesting portrayal of every grouping classification, such as training class is made. In the ensuing testing stage, these feature space allotments are utilized to arrange picture highlights. This paper utilizes Convolution Neural Network to classify images.

E. Convolution Neural Networks

At present, the most efficient deep learning method to classify the image is convolution neural network. At first it recognizes the low-level features and figure out how to perceive. Finally, it combines the features to learn more complicated patterns. It consists of several layers. The first layer is a convolution layer which acts as a feature extractor of the images. Here the input image is given to the convolution kernels which produces convolution map. The second layer is a rectified linear Unit layer (ReLU) which acts as an activation function that transforms the weighted sum of input from the node in to the activation of output for that input. The third layer is the pooling layer which reduces the spatial dimensions so that it reduces the computational complexity in the network by using Maximum function. Finally, the CNN code connects the response as a distinct vector and it is connected to the fully connected layer. The fully connected layer combines the CNN characteristics for image classification. In this paper a set of images which had both normal and affected images were chosen.The different layers which are mentioned above were created and the network was trained.Once the network was trained it was able to classify the given input image as affected or normal.[10]

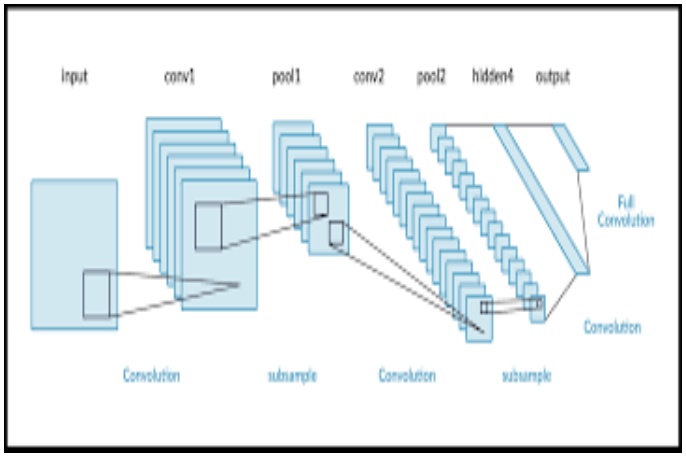


Fig.8.CNN Architecture

3. RESULTS

In this paper, in order to classify whether the images are healthy or diseased image, we have trained 500 fundus images from the online dataset out of which 250 images are used for training and the remaining images are used for testing. The training algorithm used in this model is Stochastic descent algorithm and we apply 2 training assessment accompanying 1 and 15 epochs with a learning rate of 0.0001 and the results are shown in the Table.1. The classification of disease will be predicted with an accuracy of 0.94.

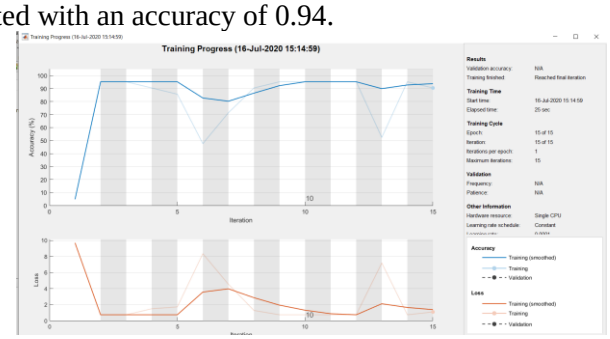


Fig.9: Accuracy and Loss

Table.1. Training Progress

Epoch	Iteration	Time Elapsed	Mini-batch Accuracy	Mini-batch Loss	Base Learning Rate
1	1	1263.4	45.28	4.23	0.0001
15	15	29337.20	94.02	1.504	0.0001

4. CONCLUSION

In order to predict whether the fundus image is healthy or diseased image, the fundus image is preprocessed, segmented to extract the blood vessel and then the arteriole venule features are extracted which is fed to a convolution neural network Classifier. The classifier defines the type of class whether it is healthy or diseased image with an accuracy of 0.94.

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