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Detection Of Malady Using Fundus ImageProcessing

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Abstract: Diseases (Malady) have a serious impact on people's life and health. Current research proposes an efficient approach to identify type of diseases in the human body based on the human fundus images. It is necessary to develop automatic methods in order to increase the accuracy of diagnosis for multiple type of maladies. In this system, multiple type diseases such as heart working, tumor, and etc disease could be identified by a new recognition method. Initially, images were preprocessed to removenoise and irrelevant background by filtering andtransformation. The method of grey-level co- occurrence matrix (GLCM) was introduced to segment images of disease. Texture and color features of different disease images could be obtained accurately. Finally, by using the HNN (CNN+RNN) algorithm, multiple types ofdiseases were identified.

Index terms: Fundus Image, Diagnosis of Malady, GLCM, Convolution Neural Network (CNN), Recurrent Neural Network (RNN)

1. INTRODUCTION

One of the most significant part in our human body is eyes which is used to see the whole world and gives color to our vision. It allows seeing things by reflecting light that falls on the objects. Human eyes are composed of retina, pupil, iris, cornea, and lens. Figure 1 shows the image of a normal eye. The eyes contain light-sensitive cells with some nerve fibers that allow light coming to the eye to be transferred as nerve impulses to the brain [1]. The light which isentering the eye is prohibited by the iris which then moves to the retina. Retina is a thin membrane of tissue which is present at the back of eye that provides central vision needed for our daily routine. As human get aged, the retina gets affected with a number of diseases. Diagnosis of maladies in human body using eyes have now become a mustbecause many people are unaware of these diseases which should be diagnosed at an early stage. It is proposed, that with the help of image processing and machine learning techniques, it is possible to diagnose the diseases from the human body using the fundus images.

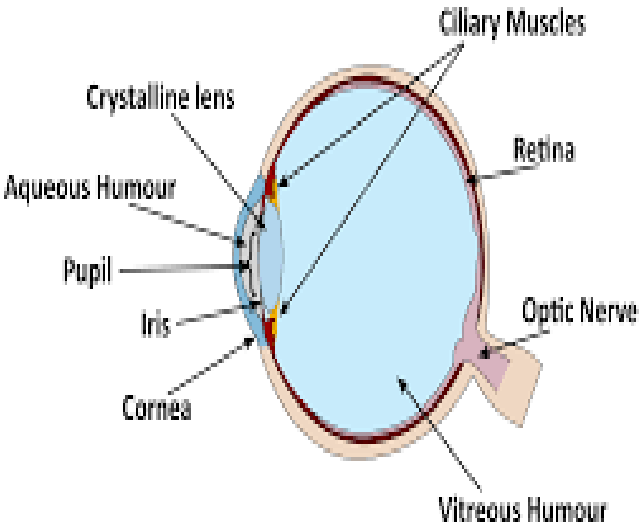

Fig 1: Normal Human Eye

2. ANATOMY OF FUNDUS

The fundus of the human eye is the interior surface of the eye which is opposite the iris lens and this fundus eye includes the retina, fovea, macula, posterior pole, and optic disc. Figure 2 shows the fundus image of an eye. The term fundus photography involves capturing the rear side of an eye also called as the fundus. There are specialized fundus cameras that consists of an intricate microscope attached camera and enabled by a flash which is used in fundus photography.

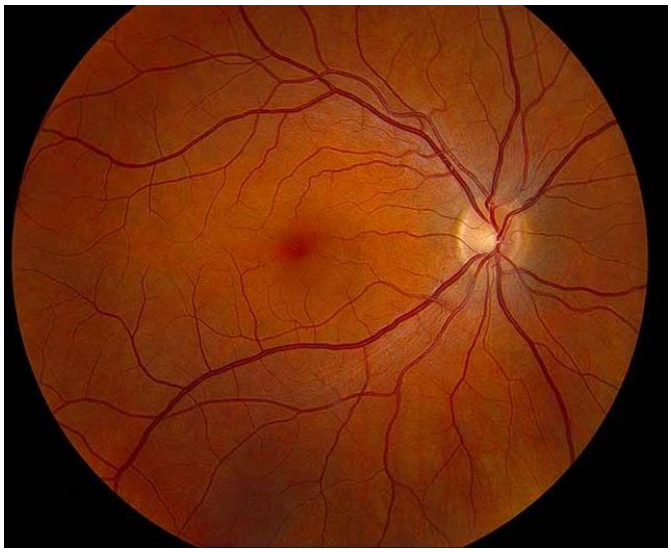

Fig 2: Normal Fundus (Eye) Image

The above figure is the color of fundus photograph of a 35-year-old healthy patient. The picture is clear, providing a crisp view of the fundus of eye. The vasculature is normal in course and caliber. The optic disc appears in pink with sharp margins and a cup-to-disc ratio of approximately 0.35. The fovea exhibits a crisp fovea light reflex. The striated sheen radiating outward from the disc is evidence of a healthy retinal nerve fiber layer. There are no lesions, pigmentary, or scars, changes in the periphery or macula. The funnel shaped depression from which the retinal vessels appear to emerge. Usually 15% cases do not show the cup. The nasal border is deeper than temporal border. The ratio if the cup disc is less than 0.4. Depth of the cup depends on size, shape, vascularity, obliquity of optic disc. Degree of development and regression are hyaloid artery and glial tissue. In relation with different structures the size and shape of the fundus changes.

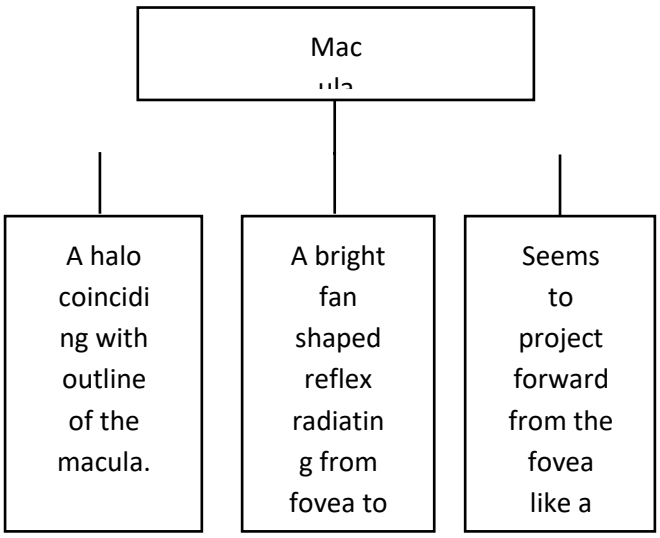

Fig 3: Variation in size and shape of fundus

3. PROPOSED METHODOLOGY

In our proposed system, the analysis method of image segmentation is employed to identify multiple diseases from the fundus image of the human eye. A number of irrelevant variables and noises can be reduced through image filtering, image rotation, and Euclidean distance transformation applied in image preprocessing. Based on this, the grey-level co-occurrence matrix (GLCM) is adopted to extract the texture feature, and the area pixel method is applied to extract the characteristics of the lesion area. Based on the region of interest (ROI) method the respective portion of the image is acquired. Figure 4 shows the block diagram of the proposed system which clearly shows the step-by-step process of the fundus image processing. Finally, the support vector machine and k-means algorithm is utilized to classify the data of different diseases according to the features of the texture and the lesion area, achieving a more ideal accuracy of recognition.

Fig 4: Proposed workflow

3.1 IMAGE ACQUISITION

A digital fundus image is produced by one or several image sensors which consists of various types of light-sensitive cameras that includes range sensors, radar, ultrasonic cameras, tomography devices, etc. Depending on the type of sensor the resulting fundus image data can be an ordinary 2D image, a 3D volume, or an image sequence. The pixel values of the image, corresponding to light intensity in one or several spectral bands can be a gray image or color images, they can also be compared to several physical measures like reflectance of sonic or electromagnetic waves, depth, nuclear magnetic resonance or absorption.

3.2 COLOR CONVERSION

The RGB of a fundus image can be viewed as three images (red scale image, green scale image and a blue scale image) which is stacked on top of each other. A grayscale image can be viewed as a single layered image. Usually in MATLAB, an RGB colored image is M*N*3 array of color pixel where each color pixel is a triplet corresponding to red, green, and blue color component of RGB image at a specified spatial location. In MATLAB there is a function known as rgb2gray() which is used to convert an RGB image to grayscale image. Figure 5 shows the color space conversion of a fundus image. The grayscale image in MATLAB is basically M*N array whose values are scaled and used to represent the intensities.

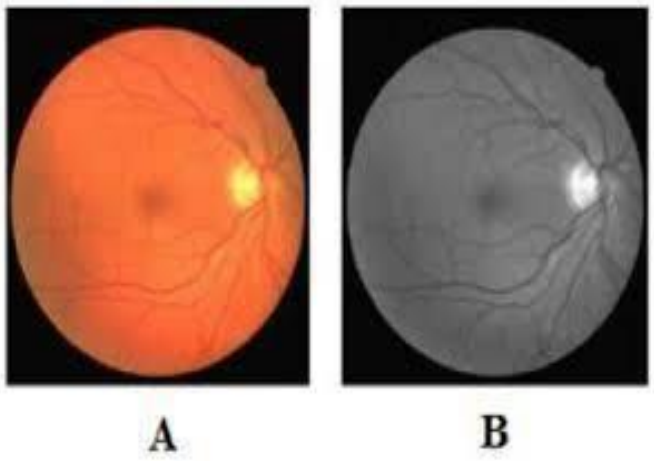

Fig 5: A-> RGB fundus B-> Grayscale fundus image

1.1 IMAGE SEGMENTATION

In digital imagerocessing image segmentation is acommonly used technique which is used to analyze and partition an image into multiple parts or regionswhich is often based on the characteristics of the pixels in that image. Image segmentation involves clustering regions of pixels based on similarities in shape and color or separating foreground from background. Figure 6 represents the fundus image segmentation. There are several techniques and algorithms for segmenting an image that have been developed over the years using domain specific knowledge which is used to solve segmentation problems in that specific application are effectively.Clustering is a methods used for separating group ofobjects in a scene. The k-means clustering algorithm finds the separation in the objects within each cluster that are close to each other and as far from other objects in other clusters. The process of image segmentation involves converting an image into a collection of regions of pixels that are represented by a labeled image or by a mask. Instead of processing the entire image by using image segmentation we can process only theimportant segments of the image. In MATLAB there are variety of segmentation tools which isused to segment the fundus image of our proposed method. The Color Thresholder App allows you to create a binary mask and apply thresholding to color images by interactively manipulating the color of the images based on different color spaces. In clustering technique using a specified clustering algorithm (K-means) you can create a segmented labeled image. Using imsegkmeans the specified image can be segmented into K number of clusters. MATLAB can train and design semantic segmentation networks with a collection of images and their corresponding labeled images. Then the trained network is used for labeling new images. For labeling the training

images Image Labeler, Ground Truth Labeler, or Video Labeler apps are used. Region growing is a simple region based or pixel based image segmentation method which examines neighboring pixels of initial seed points and iteratively determines whether the pixel neighbors should be added to the region. This can be done using the image segmenter app. To remove the border of the image the appropriate marker and mask images are chosen. The original image f(x,y) is used as the mask image and the marker image fm is defined by the following equation[1].

$f_m(x,y)$ = f(x,y) if (x,y)is on the border of f,0, otherwise

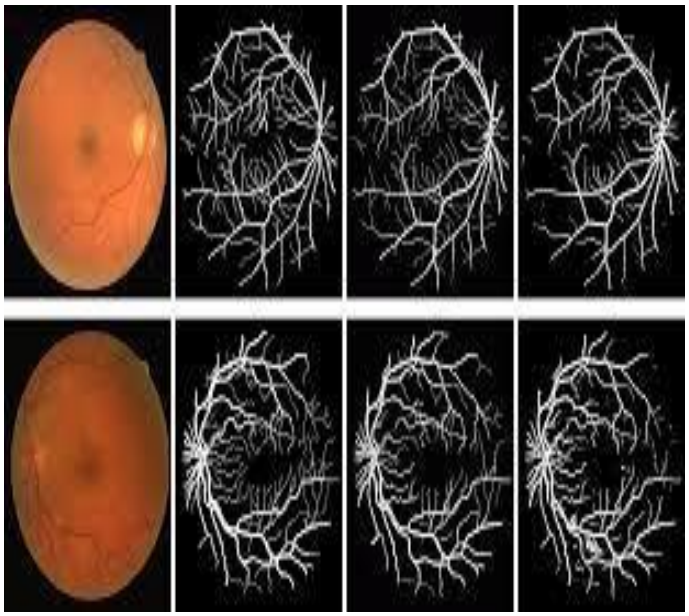

Fig 6: Image Segmentation of Fundus (Eye)

2. FEATURE EXTRACTION

In image processing, feature extraction plays a vital role and it is a special form of dimensionality reduction. Feature extraction represents interesting parts of an image as a compact feature vector. This technique is useful when the image size is too large and a reduced feature representation is required to quickly complete the tasks such as retrieval and image matching. The features are carefully chosen and extracted for expecting that the feature set that will acquire the related information from the input data in order to perform the required task using this reduced representation instead of the actual full size input. Feature extraction and detection are often combined to solve computer vision problems such as recognition and object detection. The function used to extract interest point descriptors is extractFeatures, the extractLBPFeatures is used to extract binary pattern features and extractHOGFeatures function is used to extract histogram of oriented gradients features. The detailed examination of large number of variables generally requires a huge amount of computation power and memory or a classification algorithmwhich over fits the training sample and generalizes to new samples. But feature extraction constructs the combinations of variables to solve the above problems by describing the data with sufficient accuracy.

3. CONVOLUTION NEURAL NETWORK

In neural systems, Convolutional neural system (ConvNets or CNNs) is one of the fundamental classifications to do pictures acknowledgment, pictures arrangements. Items location, acknowledgment faces and so on., are a portion of the zones where CNNs are broadly utilized. CNN picture groupings take an info picture, process it andcharacterize it under specific classifications. In lightof the picture goals, it will see h x w x d(h = Height,w = Width, d = Dimension. A Convolutional neural system (CNN) is a neural system that has at least one convolutional layers and are utilized for the most part for picture handling, arrangement, division and furthermore for other auto associated information. Actually, profound learning CNN models to prepare and test, each info picture will go it through a progression of convolution layers with channels (Kernals), Pooling, completely associated layers (FC) and apply Softmax capacity to arrange an item with probabilistic qualities somewhere inthe range of 0 and 1. The beneath figure is a finished progression of CNN to process an info picture and groups the items dependent on values. In the wake of doing this for each component pixel in each convolutional layer and each weight in each completely associated layer, the new loads offer a response that works marginally better for that picture. This is then rehashed with each subsequent picture in the arrangement of named pictures.

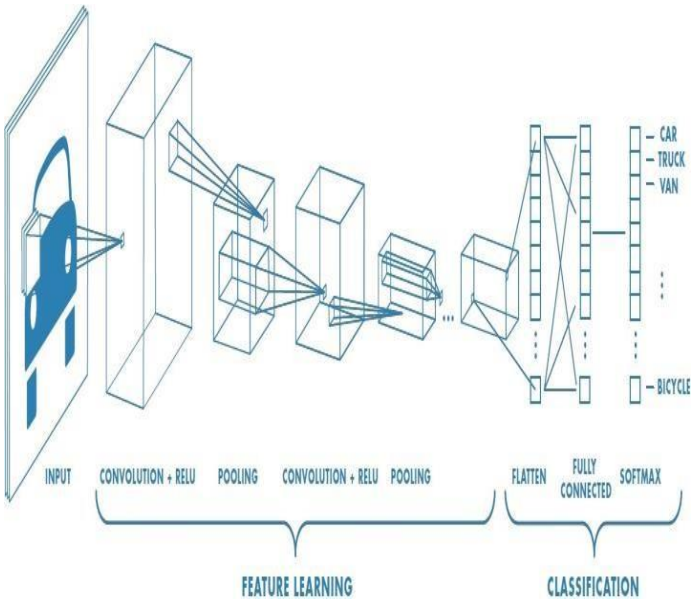

Fig 7: Neural network with many convolutional layers

The primary bit of leeway of CNN contrasted with its forerunners is that it consequently recognizes thesignificant highlights with no human supervision. For instance, given numerous photos fundus pictures it learns unmistakable highlights for each class without anyone else.

4. RECURRENT NEURAL NETWORK

A recurrent neural system (RNN) is a class of fake neural systems where associations between hubs structure a coordinated diagram along a transient succession got from feed forward neural systems, RNNs can utilize their inner state (memory) to process variable length groupings of sources of info.

CNN extricates spatial highlights and RNN removes transient highlights. Accordingly, for picture acknowledgment, it is normal to utilize CNN over RNN. For other CV issues includingvideo or picture and a few arrangements, for example, the activity acknowledgment issue and the picture subtitling issues, CNN and RNN are both utilized frequently. A RNN recalls every single data through time. It is valuable in time arrangementexpectation simply because of the element to recollect past contributions also. This is called Long Short Term Memory. Recurrent neural system are even utilized with convolutional layers to expand the viable pixel neighborhood.

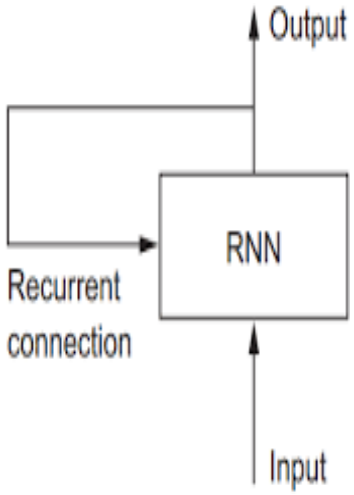

Fig 8: Recurrent Neural Network

5. RESULT AND DISCUSSION

The proposed malady detection using fundus image classification with Hybrid neural network (HNN) was simulated using MATLAB. Typical fundus image (color) is given as the input. RGB to Grayscale conversion is performed to choose an accurate threshold value and also for edge detection. To remove the irrelevant noises and unwanted spices from the binary image object classification is performed. After detecting the expanded nerve different features are extracted by applying region of interest (ROI). The features extracted are convex hull, convex image, convex area, Filled area, Filled image, Euler number, bounding box, Centroid, Extrema, Eccentricity and Perimeter are extracted. SVM is trained to detect the type of disease which affects the human body. The proposed method has been verified by taking patient images to detect the type of malady. In this approach, we proposed a method whichautomatically extracts which type of disease hasaffected the human body from fundus images. Features based on shape, brightness, contrast are classifies and calculated to determine the type of disease using Hybrid Neural Network Classifier. The proposed method performs better by segmenting even small nerve during expansion. Using MATLAB all the operation is performed.

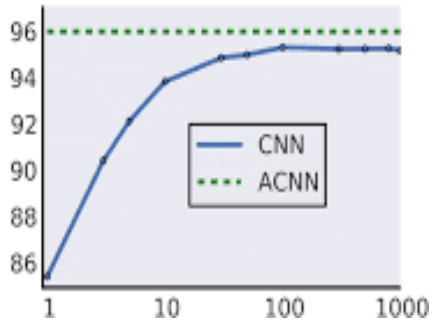

Fig 9: SVM Chart

6. CONCLUSION

In this work, detection of malady based on image procession and object classification was analyzed. The image processing of color fundus image has a significant role in the early diagnosis of diseases. In this paper the expanded nerve in the fundus image reflects the type of disease which affects the human body. The fundus images are converted to the grayscale image and feature extraction is performed. Finally the type of malady is diagnosed using CNN and RNN Classifier. The accuracy of the proposed classifier is about 90-95%. However the future algorithms can be replaced with HNN algorithm to detect the type of disease using the fundus image. The results demonstrated here indicate that it can help the doctors to detect the type of malady at the early stage.

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