ISSN No:-2456-2165

Automated Detection of Age-Related Macular Degeneration through DWT Features and Deep Learning Approach

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Abstract:- Age-related macular generation (AMD) is the major reason of sight loss for persons above 50 years of age. Automated algorithm makes possible in the early detection of AMD, by discovering variations in the blood vessel and arrays in the retina. AMD is steady damage of eye vision by rust of macula and general cause of permanent vision loss. The aim of this paper is to firstly detect the retinal disease AMD and to categorize the two kinds. In this paper, a Discrete Wavelet Transform (DWT) joined with LSDA for automated detection of AMD is proposed. The image is firstly preprocessed from chale. The extracted features are subjected to reduction through LSDA. The performance of classifier namely Deep Convolutional Neural Network (DCNN) is applied to detect the AMD disease and likened to automatically differentiate to wet and dry groups using classified LSDA factors. The results showed a classification of 97%.

Keywords:- *Age-Related Macular Degeneration, Fungus Images, Discrete Wavelet Transform, Deep Convolutional Neural Network.*

I. INTRODUCTION

Age-related macular degeneration is a main reason of eye illness which can influences people aged 50 years and overhead to loss central vision [1]. AMD is affected by retinal degeneration in the center of the retina and macula is accountable for central and sharp vision in the retina [2]. Cones is the attention of tinted bright sensitive nerve where light usually focuses in the internal layer of retina [2,3]. The middle stage usually is asymptomatic, causing in no vision loss, however, is existing before persons degenerate to a progressive stage of AMD, related with the large central vision loss affecting some chores like reading, and face recognition [4]. The report of World Health Organization (WHO) disclose that AMD affects around 22–27 million people around the world and 8 million between them are suffering vision loss [4]. In several patients Age-related macular degeneration develops gradually without influencing the vision, and its growth quickly affecting the vision loss. The initial symbols of Age-related macular degeneration are the existence of drusen's in the retina. Age-related macular degeneration can be categorized into two types i.e., Dry Macular and Wet Macular Degeneration [5].

- Dry Macular Degeneration: It is a normal AMD type and is affected owing to diluting of retina in the macula, a small white yellowish leave that procedure within the retina. It slowly and gradually increasing "darkening" of the central vision in retina.

- Wet Macular Degeneration: It's a common type of AMD which is produced because of Choroidal Neovascularization (CNV). It is an irregular blood vessel creation from choroid region of the retina. Blood vessels of retina remain curiously feeble and disposed to leaking and simply breakdown and exploit.

II. RELATED WORK

In the last few years, there are lot of work done on automatic analysis of AMD using many methods. In [6], an automated based technique for obtaining the drusen transude transude is improved by means of the retinal image psychoanalysis. Accurate morphology rule was employed to properly segment the drusen parts. The proposed system in [7] used neural network-based classifier which detects and segment the retinal diseases. An automatic drusen discovery was proposed from the color retinal images [8]. A novel approach in [9] was proposed that the geodesic reconstruction for drusen segmentation. In [10], a histogram method for proposed for automatic detection of AMD. In [11] an advent-based technique for sensing fovea and the optic diskette is proposed. The method in [12] provides a precise segmentation of vasculum of retina by resolving the spatial features. Proposed system in [13] gives a fuzzy conjunction of blood vessels method to find the optic nerve.

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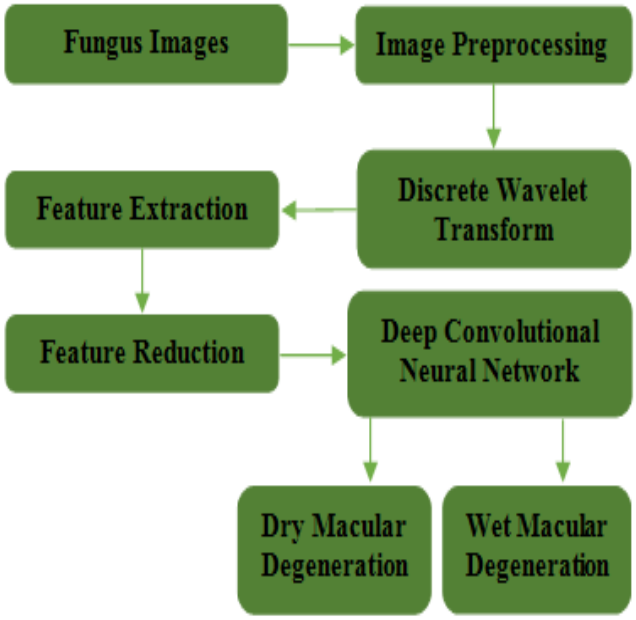

Fig 1:- Flow Chart of the Proposed System for Detection of AMD

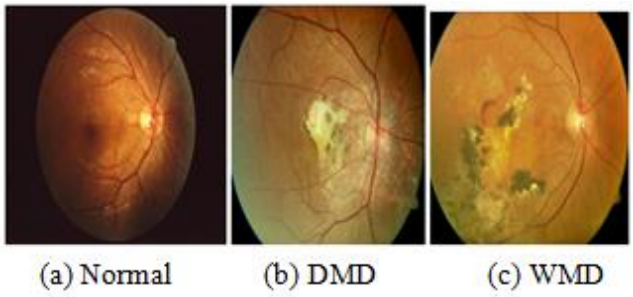

Fig 2:- Original Eyes Images

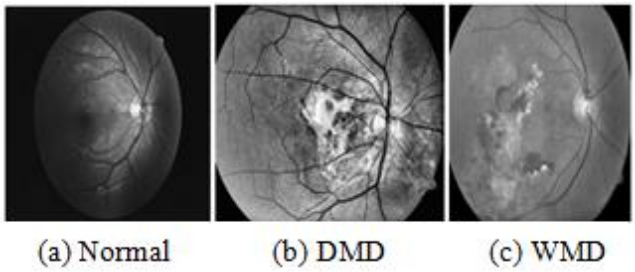

Fig 3:- Extracted Green Component Images

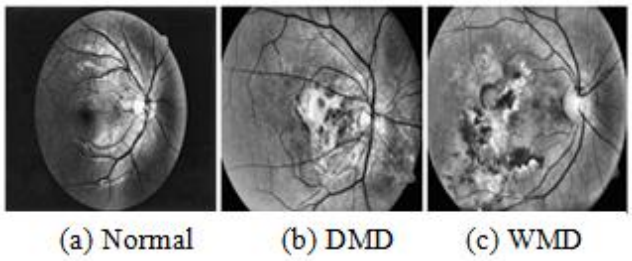

Fig 4:- Histogram Equalization Images

III. PROPOSED WORK

A. *Image Acquisition*

Color retinal fundus images were collected from Oberkochen, Germany and mydriatic eyes images were obtained with a Zeiss FF450. In this study, 200 fundus images with the resolution of 830 X 590 pixels and kept in TIFF format is collected.

B. *Pre-processing*

Pre-processing is an important initial stage in automated detection of retinal images. Image pre-processing is to increase the image information and develop some image features by removing the unwanted distortion (noise). Image pre-processing employs the redundancy in an image. To enhance the superiority of fungus images the Contrast Limited Adaptive Histogram Equalization (CLAHE) [14] is used on fundus green channel image. Using of contrast enhancement is to give the variation during the image and give an improved image. Histogram equalization method is used to improve the low contrast images.

C. *Discrete Wavelet Transform and Feature Extraction*

DWT is applied to the an-isotropic dim figure. Discrete wavelet Transform is employed to achieve multiresolution analysis using both high and low pass filters. It decays the images into low and high frequency components.

[zA,zH,zV,zD] = dwt2(T,'ctitle') **(1)**

Calculates the low frequency matrix zA and high coefficients matrices zH, zV, zD (flat, perpendicular, and slanting, respectively), attained by wavelet decomposition T where, T is the source retinal fungus image after operating an-isotropic diffusion. The estimate coefficients are operated as features for Age-related macular generation detection and it defines as the universal features of standard and Age-related macular generation fundus images. The 'ctitle' represents the wavelet name.

D. *Feature Reduction*

To reduce the feature size by finding the association among the data point and classes the Locality Sensitive Discriminant Analysis (LSDA) is operated. The within-class density Sa, and between-class separability Sb is calculated as:

$$S_a = min_q \sum_{xy} (q_x - q_y)^2 W_{,xy} \quad \textbf{(2)}$$

$$S_b = min_q \sum_{xy} (q_x - q_y)^2 W_{,xy} \quad \textbf{(3)}$$

By means of this technique all three level estimated constants are decreased to 25 Locality Sensitive Discriminant Analysis components.

E. Classification

In this paper a Support Vector Machine (SVM) and Deep Convolutional Neural Network (DCNN) classifiers has been used. In Support Vector Machine, the contribution information is plotted from two groups to form a hyperplane, where two separates classes are formed i.e., WMD and DMD. SVM operated for non-linearly separable information by means of kernel positions into a linearly one. In this paper, to classify the two classes several kernel functions i.e., linear, polynomial, and quadratic are used. The classifiers mentioned above are used and the best performance amongst them are used for final algorithm. DCNN is a feed forward network having three layers i.e., input, pattern and summation layers created on Parzens result on probability density function. In summation layer the transfer function formulates the result through the testing by means of distance vector likelihoods.

IV. EXPERIMENTAL RESULTS

The DCNN classification for AMD images is displayed in Table 1. This paper display that this classifier can find the class up to 97% in instance of normal, DMD and WMD. Five metrics are used to assess the ability of Deep Convolutional Neural Network to properly classify images for Age-related macular degeneration. In this paper, the specificity, sensitivity, positive predictive value, negative predictive value, and accuracy are calculated. The DCNN classification accuracy results displayed in Table 2 using AMD dataset.

Deep Convolutional Neural Network Classifier	
% Specificity	**97.00**
% Sensitivity	**96.2**
%PPV	**92.4**
%NPV	**94.7**
%Accuracy	**95.0**

Table 1:- DCNN Classification Results

Source Images	**Number of trained images**	**Number of tested images**	**Number of correctly classified**	**Classification %**
Normal, DMD & WMD	**200**	**100**	**97**	**97.00**

Table 2:- Accuracy of Test Data in Percentage

V. CONCLUSION

AMD is a permanent medical disorder and its analysis is very slow method. The two types of AMD are known as Dry Macular Degeneration and Wet Macular Degeneration. Color retinal image is changed into green segment after that histogram equalization is used for pre-processing. After that a Discrete wavelet transform based feature extraction is proposed to classify the differences in the components owing to AMD illness. At last, with the assistance of deep convolutional neural network (DCNN) the normal, DMD and WMD are categorized. This function decides the existence of the AMD in a patient eyes by operating the proposed methods on fundus images acquired by medical image. The classification result of the proposed system is 97.00%.

REFERENCES

[1]. N. M. Bressler, S. B. Bressler, S. L. Fine, “Age-related macular degeneration,” Survey of Ophthalmology, vol. 32, pp. 375–413, 1998.
[2]. R. D. Jager, W. F. Mieler, J. W. Miller, “Age-related macular degeneration,” The New England Journal of Medicine, vol.358, pp. 2606–2617, 2008.
[3]. P. T. De Jong, “Age-related macular degeneration,” The New England Journal of Medicine, vol. 355, pp. 1474–1485, 2006.
[4]. N. M. Bressler, “Age-related macular degeneration is the leading cause of blindness,” JAMA. vol. 291, no. 15, pp. 1900-1901, 2004.
[5]. H. R. Coleman, C. C. Chan, F. L. Ferris, E. Y. Chew, “Age-related macular degeneration,” The Lancet, vol. 372, pp. 1835–1845, 2008.
[6]. O. Sheba, A. S. Kumar, “Automated Diagnosis of Macular Degeneration through Image Processing,” vol 89, November 2008.
[7]. D. Jayanthi, N. Devi, S. S. Parvathi, “Automatic Diagnosis of Retinal Diseases from Color Retinal

Images," International Journal of Computer Science and Information Security, vol. 7, pp. 234-238, 2010.
[8]. S. Garg, J. Sivaswamy, G. D. Joshi, "Automatic Drusen Detection from Color Retinal Images," Center for Visual Information Technology.
[9]. Z. B. Sbeh, L. D. Cohen, "A New Approach Of Geodesic Reconstruction For Drusen Segmentation In Eye Fundus Images," IEEE Transactions on Medical Imaging, vol 20, pp.1321-1333, 2001.
[10]. M. H. Hijazi, F. Coenen, Y. Zheng, "A Histogram Approach for the Screening of Age-Related Macular Degeneration", Ophthalmology Research Unit.
[11]. J. Singh, G. D. Joshi, J. Sivaswamy, "Appearance-Based Object Detection in Color Retinal Images," 15th IEEE International Conference on Image Processing, 2008.
[12]. K. W. Tobin, E. Chaum, V. P. Govindasamy, T. P. Karnowski, "Detection of Anatomic Structures In Human Retinal Imagery," IEEE Transactions on Medical Imaging, vol. 26, no. 12, pp. 1729-1739, 2007.
[13]. A. Hoover, M. Goldbaum, "Locating the Optic Nerve in A Retinal Image Using The Fuzzy Convergence Of The Blood Vessels", IEEE Transactions on Medical Imaging, vol. 22, no. 8, pp. 951-958, 2003.
[14]. R. C. Gonzalez, R. E. Woods, "Digital Image Processing," 2 ed., Prentice Hall, New Jersey, 2001.