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Localization of optic Disc using New Designed Wavelet

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ABSTRACT:
Optic disc is the raised part on the retina which is at the entry part of optic nerve. Optic Disc is yellow in color and it sends the signal towards brain. It is the center point of retina. Optic disc is origin were blood vessels are grown .Optic disc localization is very important part for developing screening system of diabetic retinopathy. Localization of optic disc is also helpful to detect the retinal feature like macula and fovea. It is also helpful in the detection of exudates. In exudates detection, optic disc should be eliminate first. In this work we have used the novel approach for localization of optic disc. We have used following steps to localize optic disc. Firstly we have converted RGB image to red channel. Then Contrast Limited Adaptive Histogram Equalization is used for enhancing the image quality. After image enhancement morphological opening and closing operations are performed and adjusted the image intensity value for increasing the contrast of image. Then multilevel two dimensional wavelet decomposition is done using new designed DR wavelet and optic disc is extracted successfully. Using speed up robust feature localization of optic disc is done. For this work we have used three databases which are publically available that are DIARETDB0, DIARETDB1 and HRF databases having 130, 89, 45 fundus images respectively.
Keywords: *Diabetic Retinopathy, Optic Disc, New Designed wavelet.*

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I. INTRODUCTION

Optic disc is situated in the back of the eye, retinal nerve fibers collect to form the optic nerve. It is round in the shape. Optic disc is also known as optic nerve head because it is head of the optic nerve. It is located slightly to the nasal side of the globe. Optic disc does not contain any photoreceptors hence

Figure1: Optic Disc

it is also known as blind spot. Thus, when any light focused on the optic disc it cannot be converted into sensory impulses, and does not sent to the brain for interpretation. Location of optic disc is where the central retinal artery enters, and the central retinal vein exits the retina. Size of optic disc is about 1.5 millimeters in diameter [1].In this work we have done the localization of optic disc using new designed wavelet. Optic disc localization is very important part for developing screening system of diabetic retinopathy. Localization of optic disc is also helpful to detect the retinal feature like macula and fovea. It is also helpful in the detection of exudates. In exudates detection, optic disc should be eliminate first [2].Steps used for the experiments are Firstly we have converted RGB image to red channel. Then Contrast Limited Adaptive Histogram Equalization is used for enhancing the image quality. After image enhancement morphological opening and closing operations are performed and adjusted the image intensity value for increasing the contrast of image. Then multilevel two dimensional wavelet decomposition is done using new designed DR wavelet and optic disc is extracted successfully. Using speed up robust feature localization of optic disc is done.

II. RELATED WORK

Yogesh M. Rajput and et al have detected the retinal optic disc using Using Speed Up Robust Features For analysus of the technique they have use the database collected from Dr. Neha Deshpande and Dr. Saswade,This database includes total twenty eight images are there fourteen were fluorescein angiogram and another fourteen were high resolution fundus images. There work on high resolution fundus images. Used MATLAB 2012a, and for result evaluation used Receiver Operating

Characteristic (ROC) curve and got 92.86% sensitivity, 0% specificity and accuracy score is 0.9902 [3]

P.M.D.S. Pallawala et al proposed algorithm to detect the optic disc based on wavelet processing and ellipse fitting. Firstly apply Daubechies wavelet transform to approximate the optic disc region. Next, an abstract representation of the optic disc is obtained using an intensity-based template. This yields robust results in cases where the optic disc intensity is highly non-homogenous. After that Ellipse fitting algorithm is used to detect the optic disc contour from this abstract representation. Additional wavelet processing is performed on the more complex cases to improve the contour detection rate. Experiments on 279 consecutive retinal images of diabetic patients indicate that this approach is able to achieve an accuracy of 94% for optic disc detection [4].Jose M. Molina and Enrique J. Carmona have work for the Localization and Segmentation of the Optic Nerve Head in Eye Fundus Images Using Pyramid Representation and Genetic Algorithms.Work is done on the DRIONS database.This method obtains 95% correct result [5].

Siddalingaswamy P. C., Gopalakrishna Prabhu .K has presents a new approach for the automatic localization and accurate boundary detection of the optic disc. Iterative thresholding method followed by connected component analysis is employed to locate the approximate center of the optic disc. Then geometric model based implicit active contour model is applied to find the exact boundary of the optic disc. 148 retinal images are used for this work. The optic disc is localized with an accuracy of 99.3%. The sensitivity and specificity of boundary detection achieved in terms of Mean±SD are 90.67±5 and 94.06±5 respectively [6].

Amin Dehghani and et al have proposed a new method for localizing optic disc in retinal images. The first step of vessel segmentation, disease diagnostic, and retinal recognition algorithms is localizing the optic disc and its center. They have use DRIVE database. They have use optic disc of the first four retinal images in DRIVE dataset to extract the histograms of each color component. Then, calculate the average of histograms for each color as template for localizing the center of optic disc. The DRIVE, STARE, and a local dataset including 273 retinal images are used to evaluate the proposed algorithm. The success rate was 100, 91.36, and 98.9%, respectively [7].

III. DATABASE

For this research work we have used three databases like DIARETDB0, DIARETDB1, HRF image database.

Table 1: Database

Name of Database	Image Dimension	Field of View (FOV)	Total Images
HRF	3504*2336	45	45
DIARETDB0	1150*1153	50	130
DIARETDB1	1150*1153	50	89
Total	264		

IV. WORK FLOW

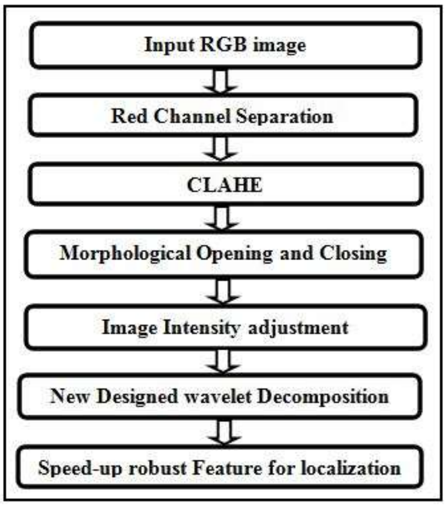


Figure 2: Workflow for localization of optic disc using new designed wavelet

V. METHODOLOGY

1. RGB image:

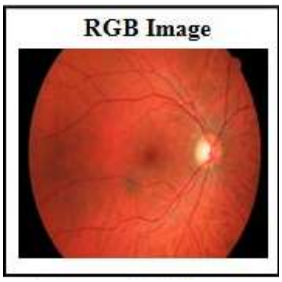


Figure 3: RGB Image

Images are uses from the databases are of RGB type. RGB images sometimes referred as a true color image [8]. In this experiment we have work on the Red channel images. We are using red channel images because the contrast for optic disc of red channel image is more than the green and blue channel. It is shown experimentally in figure 4.

2. Red Channel Separation:

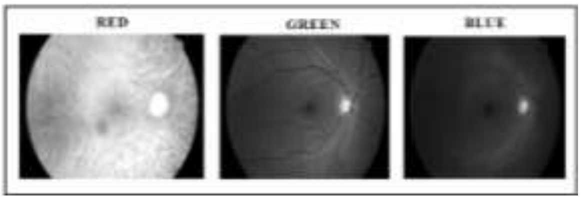


Figure 4: Red Channel, Green Channel, Blue Channel

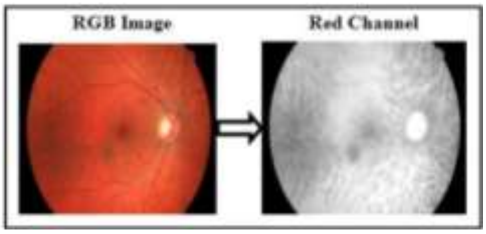


Figure 5: Red Channel conversion

We have converted the RGB image in to red, green and blue channel .In red channel contrast for optic disc disk is more as compare to green channel and blue channel. The formula for red channel [3] is as follows:

$$r = \frac{R}{(R + G + B)} \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where r= is a Red channel, R=Red, G=Green, B=Blue. R, G, B have been normalized so that they are in between [0, 1].

3. Contrast Limited Adaptive Histogram Equalization (CLAHE):

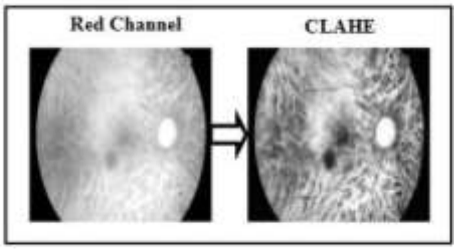


Figure 6: Contrast Limited Adaptive Histogram Equalization

After red channel extraction, applied contrast limited adaptive histogram equalization on green channel image. The formula for the contrast limited adaptive histogram equalization is given as follows:

$$g = [g_{max} - g_{min}] * P(f) + g_{min} \quad \ldots\ldots\ldots. (2)$$

Where g_{max} = Maximum pixel value
g_{min} = Minimum pixel value
g = computed pixel value
$P(f)$= CPD (Cumulative probability distribution)

By using this contrast limited adaptive histogram equalization function we have enhance the quality of image. The CLAHE algorithm partitions the images into contextual regions and applies the histogram equalization to each one. This evens out the distribution of used grey values and thus makes hidden features of the image more visible [9].

4. Morphological Operations:

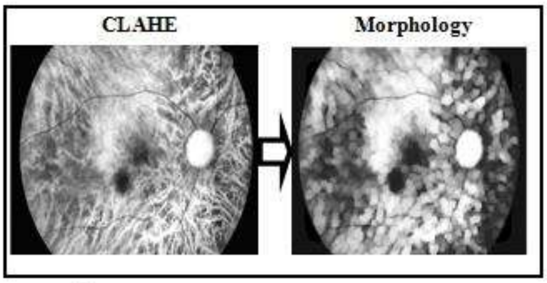


Figure 7: Morphological Operation

After image enhancement using Contrast Limited Adaptive Histogram Equalization we have performed morphological operations such as morphological closing and morphological opening. We have performed both the closing and opening operation on image to remove the noise from an image. Opening operation performs the small objects removal and closing operation performs closing small holes. Morphological opening can be described as an erosion operation followed by a dilation operation [10].

$$A \circ B = (A \ominus B) \oplus B, \quad \ldots (3)$$

Morphological closing is dilation operation followed by erosion operation [11]

$$A \bullet B = (A \oplus B) \ominus B, \quad \ldots (4)$$

Where $\ominus$ and $\oplus$ denote erosion and dilation, respectively

5. Image Intensity Adjustment:

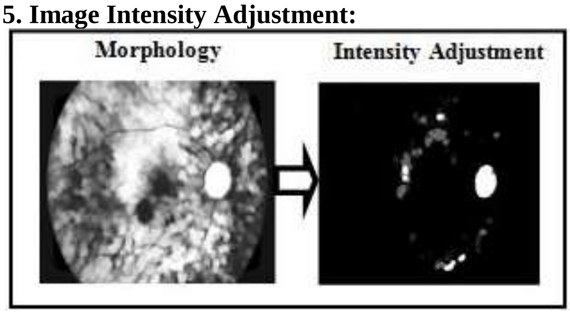


Figure 8: Image Intensity Adjustment

After morphological opening and closing operations we have done the intensity adjustment. We can performs gamma correlation on an image using the imadjust function to perform power law transform [12] [13].Power law transformation function is as follows

$$s = cr^\gamma \; \ldots\ldots\ldots..(5)$$

Where C and γ are positive constants and r be the intensity of an image (range 0 to 255) [12].

6. Wavelet Decomposition (Designed DR Wavelet):

After image intensity adjustment we have done wavelet decomposition using new designed wavelet named DR. Steps to design wavelet is as follows:

Step1: Create orthogonal wavelet of type 1

Step2: Create a filter

a=3;

sq =a*a;……(6)

DR = [(2+sq)(4+sq)(4-sq)(2-sq)]/16 ;….(7)

Step3: Add the new wavelet family to the stack of wavelet families.

Step 4: Display the two pairs of scaling and wavelet functions

Step 5: We can now use this new orthogonal wavelet to analyze a signal or image

We have applied DR wavelet decomposition on intensity adjusted image and the result is shown in the following figure 9.

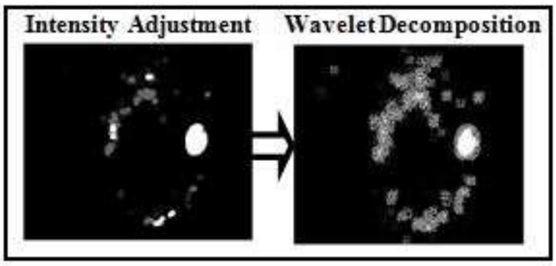


Figure 9: Wavelet Decomposition

7. Speed up robust feature:

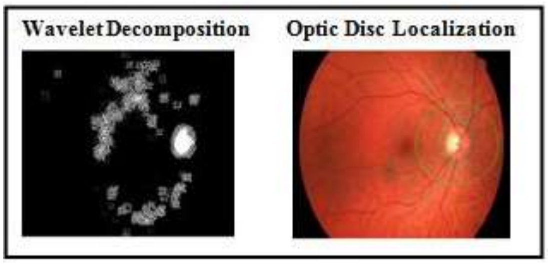


Figure 10: Optic Disc Localization

$$I_{\Sigma}(x,y) = \sum_{i=0}^{i\leq x} \sum_{j=0}^{j\leq y} I(x,y) \ldots\ldots\ldots.(8)$$

After new wavelet decomposition we have applied speed up robust feature. With the help of speed up robust feature [3] we have localize the optic disc. I is the input image and a point (x; y) the integral image is calculated by the sum of the values between the point and the origin.

VI. RESULTS

In this experiment we have localize the optic disc. We have use the publically available databases that are DIARETDB0, DIARETDB1 and HRF database having 130, 89, 45 fundus images respectively. We have done all the work in MATLAB 2013a.For the evaluation result we have calculated the TP, TN, FP, FN value for the localization of optic disc, and calculated its accuracy.

True Positive (TP): There was optic disc and System shows optic disc.

True Negative (TN): There was no optic disc and system shows no optic disc.

False Positive (FP): If macula and lesion shows as optic disc.

False Negative (FN): If there was optic disc and system did not show optic disc.

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN} \ldots\ldots..(9)$$

Table2: Localization of optic disc using New Wavelet

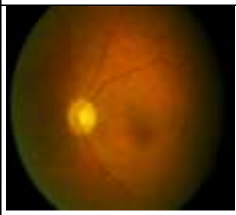
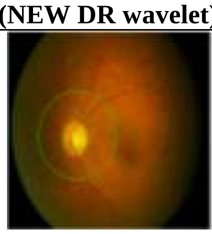
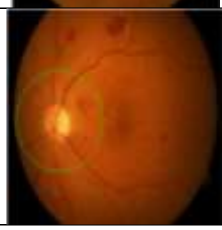
Image	**RGB image**	**Localized Image (NEW DR wavelet)**
image 004 (DIARETDB0)		
Image 006 (DIARETDB0)		
image 008 (DIARETDB1)		

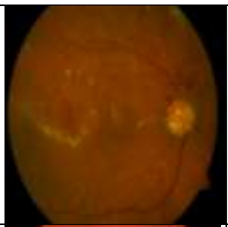
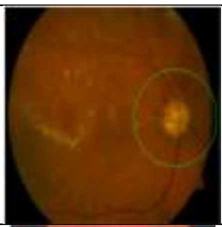
Image 0016 (DIARETDB1)		
01_h (HRF)		
12_h (HRF)		
12_g (HRF)		
15_g (HRF)		
01_dr (HRF)		
08_dr (HRF)		

Table 3: Result of localization of optic disc using new wavelet

Sr. No.	Database	No. of Images	Correctly Detected Optic Disc	Accuracy
1	DIARETDB0	130	119	94%
2	DIARETDB1	89	86	97%
3	HRF(Healthy)	45	44	98%

VII. CONCLUSION

In this experiment there is localization of the optic disc using new wavelet decomposition on the DIARETDB0, DIARETDB1,HRF database having 130,89,45 fundus images respectively. We have calculated true positive, true negative, false positive, false negative values, and calculated accuracy. We have done all the work in MATLAB 2013a. We got overall 94%, 97%, 98% accuracy of the DIARETDB0, DIARETDB1,HRF databases respectively for the localization of optic disc using new wavelet. Result in detailed is shown in the table 3.

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