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Automatic Detection of Optic Disc for Diabetic Retinopathy

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Abstract: ***Diabetic Retinopathy affects the retina of the eye. Ultimately it may lead to total visual impairment. Total blindness can be avoided by detecting Diabetic Retinopathy at an early stage. Various manual tests are used by the doctors to detect the presence of disease but they are tedious and expensive. Some of the features of Diabetic Retinopathy are exudates, haemorrhages and micro aneurysms. Detection and removal of optic disc plays a vital role in extraction of these features. This paper focuses on detection of optic disc using various image processing techniques, algorithms such as Canny edge, Circular Hough(CHT). Retinal images from IDRiD, Diaret_db0, Diaret_db1, Chasedb and Messidor datasets were used.***

Keywords: Canny edge, Circular Hough(CHT), Diabetic Retinopathy, Image processing, Optic disc.

I. INTRODUCTION

Diabetic Retinopathy mostly occurs due to the damage of blood vessels which provide nutrition to the retina of the eye. These blood vessels when damaged, leak fluids and distorts the vision. Haemorrhages and exudates are the earliest symptoms of DR which appear as red and yellow lesions in the retina. DR usually affects the middle aged and elderly people. It is expected to grow up to 192 million by 2035. The people who are diagnosed with diabetes are mostly prone to Diabetic Retinopathy. The probability of developing DR increases with age and rise of blood sugar level and blood pressure. As the severity of disease increases, it leads to severe vision problems. Optic disc is an area where optic nerves connect to the retina which is behind the eye, it is also called optic nerve head. It is approximately circular in shape and appears as a bright yellowish region where blood vessels converge towards it. Most of the features of optic disc match with those of exudates. Detection of optic disc plays a crucial role in detection of the disease. Removal of optic disc by using image processing techniques and morphological operations was proposed. This paper is divided into five sections which are described below which are related work, methodology, experimentation and results and conclusion.

II. RELATED WORK

Several methods have been practised for the detection of DR in the early stage with the advancement of technology.

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Various algorithms were developed to detect optic disc, including morphological approaches [6]. Nidal.K et al developed an automated algorithm which detects the optic disc with mathematical formulae [6]. Zhang Zhuo et al proposed extraction of Region Of Interest (ROI) of optic disc which will take less time to process than whole image[7]. Brian.A et al proposed a series of Circular Hough Transform, CLAHE, gabor filter and thresholding techniques are utilized [4]. Kim Jongwoo et al suggested a four step methodology to detect the optic cup by extracting ROI and further extracting the optic cup[1]. Zhang et al utilized random forest for classification and extracted 28 features including texture and geometrical related features [5]. Lokurarchichi et al proposed normalization to adjust brightness in images, detecting the optic disc followed by extracting true and false exudate candidates. This is testes on 89 images of Diaretdb1 and 130 image set of Diaretdb0 [2]. Kemal et al put forward a combined procedure of Canny and Circular Hough to prevent the interference of optic disc for the improvement of fundus images shown in Fig.1 [13]. In all the methods prevention of interference of optic disc is done but most of them are complex processes with a series of complex algorithms involved. In our paper we provide a simple way to mask the optic disc which is critical for any retinal image processing.

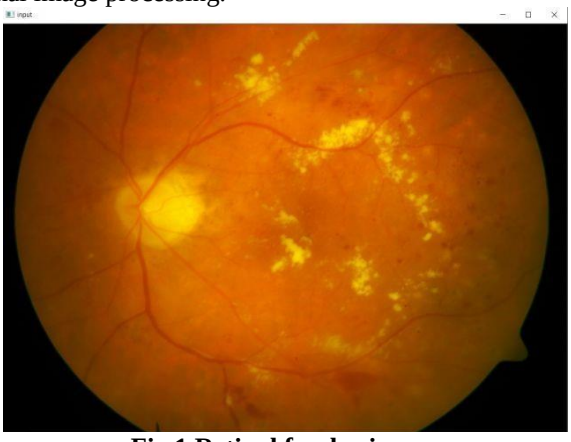

Fig.1 Retinal fundus image

III. METHODOLOGY

Optic disc must be removed to get better results for the segmentation of features. The optic disc appears as brighter area in the retinal image. As shown in Fig.1, the results may not be accurate if CHT is applied to the region of interest as shown in Fig.3. The suggested method comprises a pre-processing stage. The pre-processing stage includes extracting Region Of Interest (ROI) from an image and enhancing the features of ROI for better processing. The proposed methodology is shown in Fig.2. and it consists of four sections that are given by data acquisition, pre-processing, detection of optic disc and masking of optic disc.

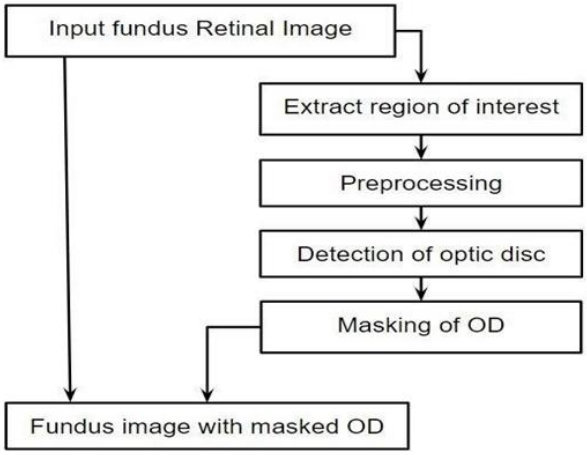

Fig.2 Methodology

A. Data Acquisition

The retinal images which are taken from four databases IDRiD, Diaretdb0, Diaretdb1 and Messidor. IDRiD[11] consists of 54 samples, Messidor[12] consists 100 samples, diaretdb1[13] consists 89 and Diaretdb0[14] has 130 samples. All the collected datasets are resized are resized to an image scale of 1025 x 720 pixels.

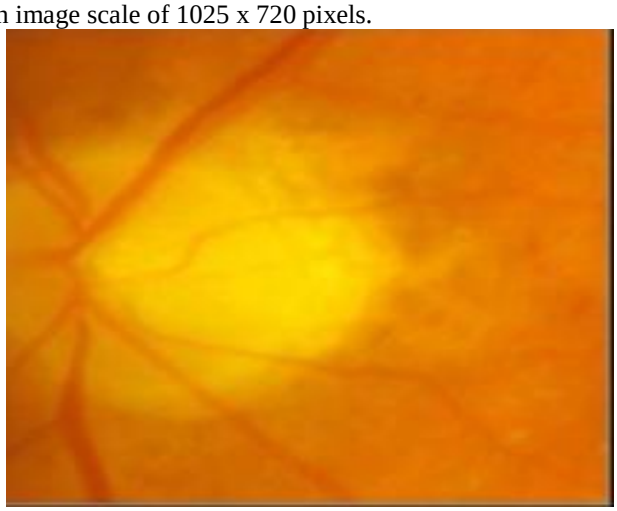

Fig.3 Region of Interest

B. Region of Interest (ROI)

ROI of an image is taken before it is processed because the retinal fundus images are high in resolution and have larger size. The location of pixels with high intensity is taken by applying minmaxloc, an image processing function. It returns location and value of pixel with minimum and maximum intensity. From the location of pixel having maximum intensity, an area with the dimensions of 110 was extracted as shown in Fig.3. This is the ROI.

C. Pre-processing

From the ROI red channel is extracted. Gaussian Blur is applied on the resulting image. It is further pre-processed by using histogram of image and a few morphological operations. Fig.4 shows the resulting image.

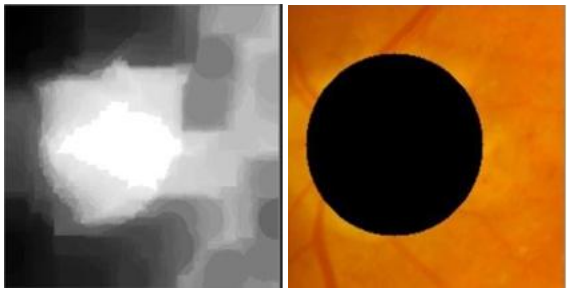

Fig.4 Pre-processed ROI **Fig.5 Masked OD**

D. Detection and masking of Optic Disc

The pre-processed ROI is subjected to the canny edge [10] to suppress noise and detect the edges as shown in Fig.4. On this edged ROI, CHT is applied. It detects the optic disc which is approximately in circular shape and region is masked as shown in Fig.5. The coordinates of ROI were mapped with the original image. The Fig.6 represents the image with masked optic disc.

Finally obtained image is exempted from optic disc and can be used for extraction of other retinal features in detection of Diabetic Retinopathy.

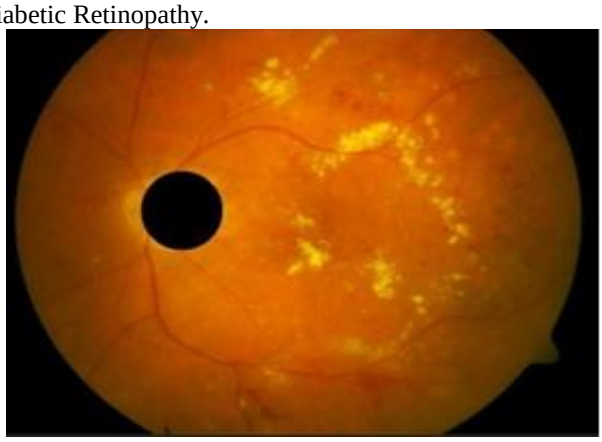

Fig.6 OD masked Retinal Image

IV. EXPERIMENTATION AND RESULTS

The algorithm is tested for the databases IDRiD, Messidor, Diaret_db0, and Diaret_db1. In IDRiD dataset, out of 54 samples, optic disc was correctly predicted in 50 samples. In Messidor dataset, out of 100 samples, optic disc is not present in 2 of them. Diaret_db1 has 89 samples and Diaret_db0 has 130 samples out of which 8 samples don't contain optic disc.

Table.1 Accuracy table

Name of Dataset	# Sample	Accuracy
IDRiD	54	92.5
Messidor	98	95.6
Diaret_db1_v_1_1	89	86.5
Diaret_db0_v_1_1	122	95.9

The series of outputs are shown to depict the algorithm presented in this paper. Plot of Accuracy and Samples is shown in the Fig.7.

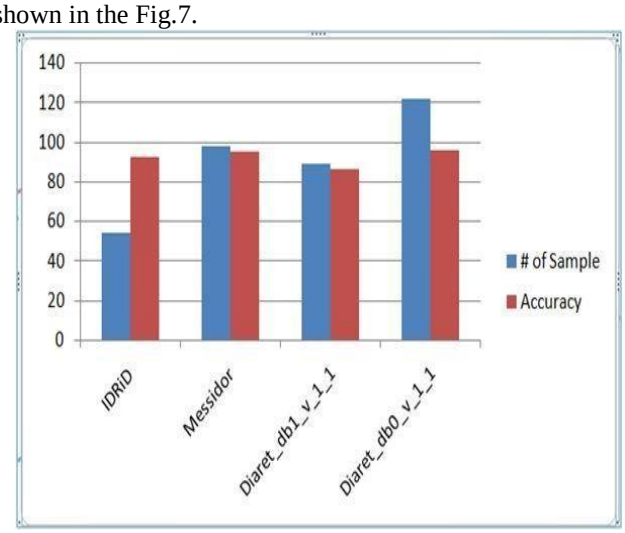

Fig.7 Accuracy Plot

V. CONCLUSION

Diabetic Retinopathy is widely known variant of diabetic eye disease. The people who are diagnosed with diabetes are mostly prone to Diabetic Retinopathy. If detected and diagnosed in early stages, it can be reduced significantly. Detection of optic disc plays an important role for extraction of any of the retinal features. The detection and masking of optic disc was proposed in this paper by using Circular Hough Transform, Canny Edge Detection and morphological operations.

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