An Effective Screening System to Detect Diabetic Retinopathy by using Dehazing Technique

L. Saravanan, K. Senthil Kumar, Nami Susan Kurian, A. Balaji

Abstract: The Diabetic Retinopathy (DR) is playing a crucial role in clinical data analysis to diagnose abnormality in retina. Many situations the early stage of patient is not aware of any symptoms until it is too late for effective treatment. The abnormality in the blood vessels of diabetics, a way will be paved for prompt diagnosis of DR. In this work, we proposed the Dehazing method of fundus image to detect and classify the disease condition based on changes in blood vessels using thresholding segmentation technique using mean square error (MSE). Then formulate the area of extracted blood vessels in the subsequent analysis to classify accurately.

Keywords: Retinopathy Classification, Median Filter, Dehazing, Thresholding, Segmentation and Mean Square Error.

I. INTRODUCTION

Diabetic Retinopathy is known as a term associated with retinal complications. The progress of the disease can be initially detected by the basic screening and timely intervention. As the number of eye specialists who can screen this disease is less than the people who are affected by this disease, there is a necessity for automated diagnostic system, so that only the affected persons can only be referred to the specialist for further intervention and treatment [2]. The different methods and stages in DR are analyzed and examined for various aspects. The Micro aneurysms are the earliest clinically visible changes of DR with red dots and hard exudates are yellow lipid deposits [8] [11]. The image processing tools are used for automated analysis to detect the severity and to support the specialist in the intervention of effective screening process [10] [13]. These patients require a frequent screening to relieve the burden on the specialist to prevent distinctions of blindness.

This can vary from micro aneurysm and hemorrhages to exudates-soft cotton wool spots and hard exudates. To detect this automated diagnostic system is used to extract the features of object [16]. Nowadays 382 million persons are affected by diabetic and this number will increase to almost 592 million by 2030 in the world [8]. The major cause of blindness in middle as well as older age groups [2].

According to Report on National Health Service (NHS), 1,280 latest cases are caused by DR are reported every year on England alone. Also, the related vision loss occurred in the country reported more than 4000 Persons. The presence of abnormality growth in Hard exudates, Hemorrhages and blood vessels is given in fig.1.
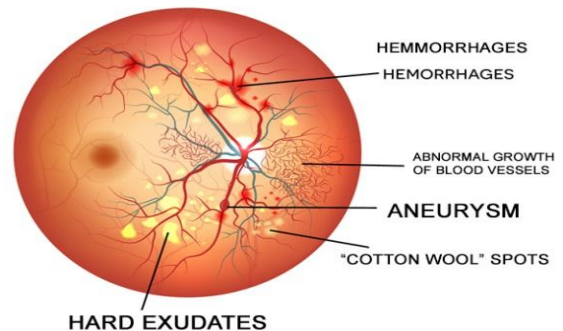

Figure 1. Image of DR

From the observation details, most of the prevalence by Asian Indians - 11.2%

Filipinos 8.9%

Chinese 4.3%

Other Asian groups 8.5%.

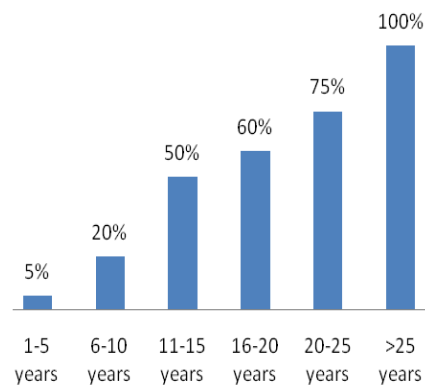Figure 1 shows that age wise rise of DR with progression of diabetes.

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Figure 2. Association of DR with duration of diabetes

II. IMPLEMENTATION METHOD

A. EXISTING SYSTEM:

In the existing system, the segmentation involves two methods, namely supervised and unsupervised methods. Supervised method based on machine learning [1] and deep learning CNN Method [5] [9] and unsupervised based on mathematical morphology [10]. In 2016, Pawel Liskowski, et-al [14] [3] proposed a paper based on supervised segmentation method used an deep neural network trained on a huge data samples are pre-processed for geometric transformations and gamma corrections. In 2016, W.Arjun Raj Rajanna et.al [15] proposed a modified digital retinal photography known as fundus photographs have regularly to be used as the input image for feature extraction, disease classification. Initially a set of preprocessing and data augmentation techniques is utilized the image quality and data presentation in fundus photograph and then an explored green channel and histogram equalization is used to represent the fundus photographs in a more compact manner for a neural network classifier [4] [12]. The manifold work here in the image is tedious and it includes a lot of mathematical procedures and any slight deviation results in larger variation in the resultant image. In 2015, Le Wang, et.al [16] projected an automatic unsupervised vessel segmentation analysis method which is greatly used for retinal images. Initially, a multi-dimensional vector is created using morphological function and then neural network based approach has been applied. The result from neural network output layer define the class of abnormality [3][7]. This paper performance limited by the small size object and small mean difference, the large discrepancy of the object and the background intensity and large noise amount.

B. PROPOSED SYSTEM:

Dehazing methods is implemented to resolve the illumination correction in the proposed system. The Fundus image stands taken from DRIVE database and Dehazing method is implemented to increase the quality of brightness of the image. Median filter is used filter white Gaussian noise by replacing all pixels in the input image with luminance larger than level with value 1 and all others by 0. Then the area of affected and the gaps are detected using skeleton components which are used to fill up the remaining gaps in order to detect the disease and the image is segmented using Threshold technique and connecting components are used to track the edges of the blood vessels and area of affected is calculated by,

$$\sqrt{p} \times 0.264 ....(1)$$

Where p denotes number of white pixels in the fundus image. The retinal images are dehazed and segmented to analyze the defects in blood vessels of the retinal images.

Here we have used enhancement technique to dehaze the retinal image and from the dehazed image, the defects have been analyzed in the blood vessels by the Thresholding techniques.

III. IDENTIFICATION OF GLAUCOMA IFUNDUS IMAGE

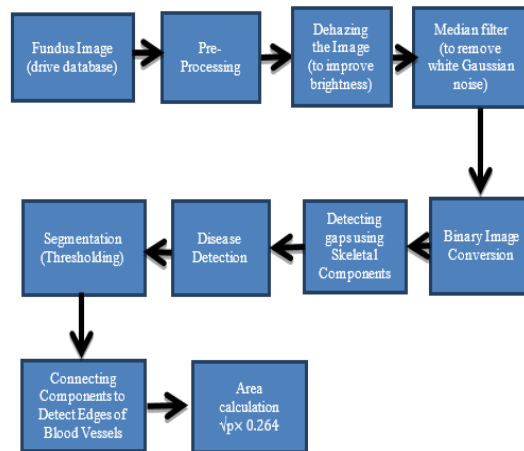The fundamental block diagram of Diabetic Retinopathy detection system as shown in figure.3.

Fig.3.Proposed method block diagram
Figure 3. Block diagram of diabetic retinopathy detection system.

1. Dehazing the image

From the scattering effect of atmospheric particles, images captured in sundry nebulous conditions are suffered from contrast attenuation and color distortion, which rigorously affect the performance. Different types of methods have been developed to improve the quality of the funded images. Retinal photography is consisting of a fundus camera with a specialized low power microscope to capture simultaneous illumination of retinal images. During the image extraction this camera can produce high quality digital color images along with luminosity and contrast variation in the light reflected by the retinal surface. Irregular illumination can produce some severe distortions in the resulting images which in turn diminishes the visibility of anatomical structures. This demotes the performance of the automated segmentation done over these structures. Dehazing of retinal image is required to clear the hazy condition in the retinal fundus image.

2. Dehazing Algorithm:

We summarized the study of fog and haze removal method for funded image processing using Dark Channel prior technique. Fog removal method beneficial for numerous vision applications and many algorithms is proposed so far which helps in efficient removal of fog.

But dark channel provides better promising results as it provides the following information: (a) identifies the region with a higher concentration of fog (higher intensities) (b) gives information on a rough estimation of the thickness of fog. After this, for getting the haze image, we use estimate transmission. The existing method does not reduce the noise and unevenly illuminated problem. The proposed Dehazed algorithm overcomes these problems and also obtains a noise free image.

3. Preprocessing

The median filter is used to clear impulsive noise and to improve the clarity of the funded images. The impulsive noise varies in the result of output signal because of external interference or reduced sensor configuration. The middle or median of this sequence is chosen as representative brightness for the neighborhood. Consequently, each pixel of the filtered image is defined because the median brightness value of its corresponding neighborhood within the original images.
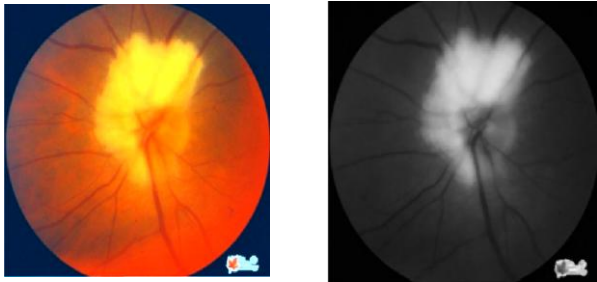

Figure 4. Fundus retinal image and filtered images

4. Vessel Extraction

Poor contrast in the vessels is due to two main reasons: (a) non-uniform lighting condition
(b) limited dynamic range of imaging sensor used to capture the retinal image.

- After improving the contrast, the image is convolved with a kernel to produce a mean image.
- Then, the mean image is subtracted from the contrast-adjusted image to perform background normalization.
- For better enhancement of the vessel structure, the output image of background normalization step is contrast adjusted one more time.
- The most important attribute in our proposed method is that:
  (a) it produces best quality and totally automatic BE
  (b) This is helpful for the eye care professionals for patients screening, treatment, evaluation, and clinical study.

Figure 5. Vessel Extraction image from filtered image

During this method the image background at corners is first modified then a homomorphic filter is applied to smooth the pictures this may enhance the brightness of the pictures as compared with the first images using an automatic thresholding technique to the blood vessels.

5. MSE Calculation:

From the statistical analysis the mean square error (MSE) and mean square deviation (MSD) of an estimator measures the average of the squares of the errors and deviations. The error could occur in the funded image due to randomness or the estimator's unaccountability of information.

$$\text{MSE} = \frac{1}{n}\sum_{i=1}^{n}(Y_i - \hat{Y}_i)^2 ....(2)$$

This can be calculated for a particular sample with an estimator

$$\text{MSE}(\hat{\theta}) = E_{\hat{\theta}}[(\hat{\theta} - \theta)^2]..............(3)$$

The error is an expectation, which is unknown and not a random variable with the function of unknown parameters.

IV. RESULTS AND DISCUSSION

In this work, we are examined the DR blood vessel extraction and disease analysis using measured area value. In future, using this funded image the system can be analysis and detected other diseases with help of proposed system. In this the fundus image is taken from DRIVE database and simulated using MATLAB software and classified by SVM classifier. Various images are considered and their simulation results are discussed and tabulated in table.1.
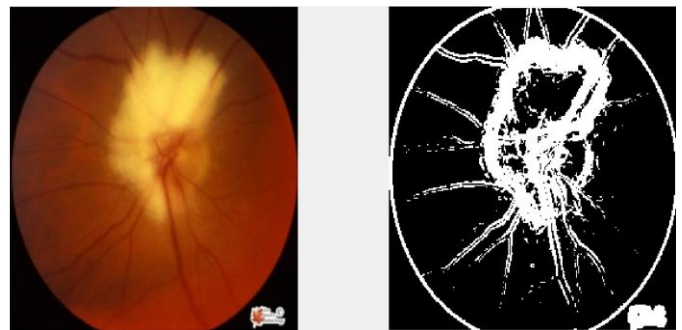

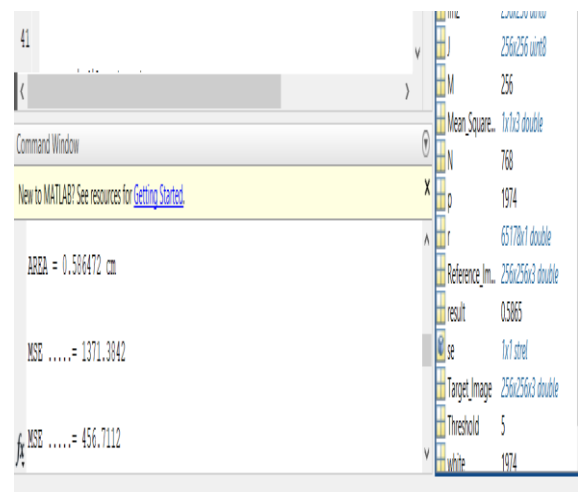**Figure 6. Dehazing funded image and extracted blood vessels**

Figure 7. Simulation result of Area Calculation

Table 1. Shows the output obtained by the processing techniques and the values estimated from the process calculated area

Image Name	Calculated White pixels	Calculated Black pixels	Disease Analysis	Calculated Area(cm)
Sample 1	3053	6806	Glaucoma	1.08898
Sample 2	3114	6771	Glaucoma	1.086176
Sample 3	2827	7055	Glaucoma	1.108721
Sample 4	750	9088	No Defect	1.258369
Sample 5	291	9571	No Defect	1.291376
Sample 6	349	9490	No Defect	1.2859
Sample 7	288	1974	No Defect	0.586472

V. CONCULSION

In this paper, we depict how we made a framework and a model fit to screen DR automatically by using MATLAB. The preprocessing technique, green channel extraction, median filtering and edge tracking method improve the brightness quality of the fundus image. The proposed method can support for the timely diagnosis and treatment for affected area that can easily prevents the vision problems. This method is an effortless technique that enables to detect the glaucoma. For the automatic screening system, our work significantly contributes in the evaluation to predict the abnormalities. The developed system combines the different modules to support the physician during diagnosis process. Also, this process can be extended for the features like, Drusen, Cotton Wool Spot and etc.

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