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AUTOMATIC DETECTION OF MICRO ANEURYSM AND DIABETIC RETINOPATHY GRADING IN FUNDUS RETINAL IMAGES

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ABSTRACT:

Image processing founds the applications in various medical fields. A cluster of research has been carried out in last decade and images processing is found to be superior to other environments in medical field. In a research it has been proven that the chances of blindness are 25 times more in the patients of diabetes than that of non diabetic person. Automatic detection of the micro aneurysms is really challenging. Diabetic retinopathy (DR) has severe affects on retina and results in loss of eye sight. The research is carried out to understand the diabetes disease in India and it is found that, this disease is increasing rapidly. The percentage of people dead due to diabetes is also very high. Most of the times, this disease is neglected by patient and in some cases the people are unaware that they have diabetes.

In this paper, authors have implemented the automatic detection of micro-aneurysm and diabetic retinopathy grading in fundus retinal images.

KEYWORDS: Diabetic Retinopathy Grading, Micro

INTRODUCTION:

More than 62 million people of India are recorded with diabetes till 2015. Diabetes is found to be one of the severe diseases in India. A research has proved that most of the times people are unaware of this disease and the care to be taken. Due to this, it becomes more severe. It is the need of the time to detect this disease before one person faces blindness.

One has to face the long term illness of diabetic mellitus due to the damage of retina which results in Retinopathy [1]. Vanes and capillaries get enlarge i.e. swelling. The swelling results in rupture and allow blood to leak into near retina [2]. If a person has diabetic history over 10 to 15 years, has to face such blindness in 80% of the cases [3]. The capillaries are invisible in the colour images and hence the micro aneurysms appear as isolated dots of diameter smaller than 100µm. There are no symptoms of this disease at start but in later stages it may results in blindness. During eye check up the Fundus Fluorescine Angiography (FFA) technique is used, but detection of Micro aneurysm is really difficult by this method. [4].

Unless the visual loss is noticed, patient is unable to notice diabetic retinopathy. Commonly patients and their ophthalmologist cannot notice diabetic retinopathy symptoms until visual loss develops. Early stages detection of this disease and with using laser photocoagulation can prevent major vision loss [5].

PROBLEM DEFINITION:

It is also complicated to distinguish whether a red lesion is a microaneurysm or small dot haemorrhage. The overall accuracy of auto detection system is less due to this problem. This problem can be addressed by improving the detection system in order to identify the disease. The system we are implementing could detect the disease in early stages. It is very beneficial for doctors and patient to have such efficient system.

PROBLEM SOLVING STRATEGY:

To embark upon this problem, a prototype system based on the image processing has been developed. This system initially pre-process the image using various pre-processing techniques to condition or enhance the input image and then candidate extraction methods are applied to the pre-processed image. One of the main difficulties based on the earlier work is that after pre-processing the image, the candidate extraction is followed and candidate extractor detects only a limited amount of MAs, while it would be essential to achieve a high sensitivity at this stage. Therefore, combinations of pre-processing methods and candidate extractors are considered and the best performing pair of pre-processing and candidate extractor is evaluated and then given to the classifier. In the testing stage, the classification is done based on the counts of Microaneurysms which helps to detect and grade different stages of Diabetic Retinopathy like, Microaneurysms ,Haemorrhages, Hard exudates and Soft exudates, that indicate the severity of the disease. Block diagram of the implemented work is as shown in figure 1.

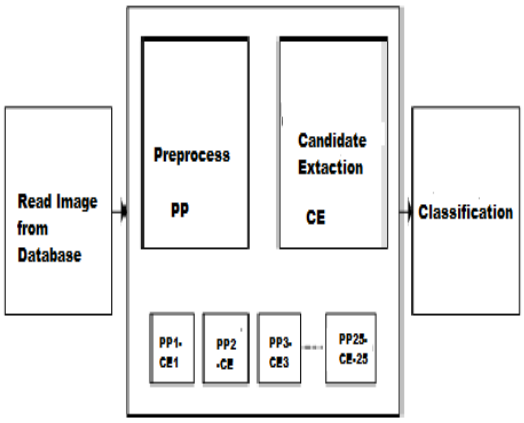

Figure1: System Block diagram

Once the Microaneurysm is detected, it can aid the patient to take proper treatment at the earlier stage and prevent from further severe stages of DR that could cause blindness. Therefore, this tool not only detects microaneurysm but also the further stages of DR, which could assist the ophthalmologists accordingly for intervention, thus making it a very effective tool for effective screening of Diabetic Retinopathy patients.

OBJECTIVES OF WORK:

Implemented task includes designing a prototype system based on the image processing technique. Objectives of the work comprises of the following steps:

1. Image acquisition
2. Pre-processing of the image for smoothening and reducing the noise by using appropriate pre-processing techniques
3. Candidate extraction methods like, diameter closing, local vessel detection, circular Hough Transformation, multi scale correlation coefficients and cross section profile analysis are applied to the pre-processed image
4. The combinations of pre-processing methods and candidate extractors are considered which are trained. The combinations of pre-processing methods and candidate extractors are considered for increasing the accuracy. The best performing combination is then given to the classifier
5. In the testing stage, the classification is done to detect Microaneurysm
6. Based on the counts of Microaneurysms, grading of different stages of DR is done that indicate the severity of the disease.

GUI WITH RESULTS:

This section demonstrates the GUI of the system.GUI has been designed using MATLAB R2013a toolbox for executing each step smoothly as shown in Figure2, below.

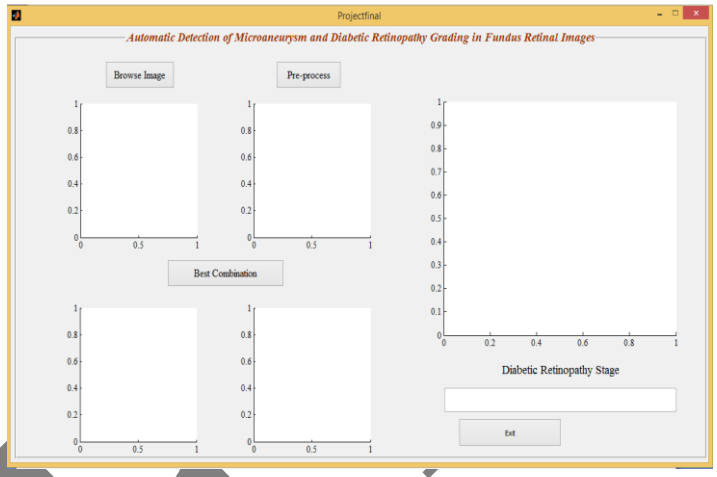

Figure2: Graphical User Interface [GUI] of the system

As shown in fig.2, developed GUI consists of four different windows. First window is used to browse the image from the database. Next window carries the five different pre-processing stages like, polynomial contrast enhancement, CLAHE, Blood vessel removal, Illumination Equalization and no pre-processing. This window displays the pre-processed images one after another with an appropriate delay provided. After carrying the pre-processing, the next window beneath pre-process does the job of displaying the best combination or the pair of pre-processing and candidate extractor. The final window displays the final result of testing which indicates the desired stage of DR.

Application of different pushbuttons used in GUI, is illustrated in table 1, below.

Table 1: Different pushbuttons with application in the developed GUI

Sr. No.	Name of the Push button	Application
1	Browse Image	Browse the image from database
2	Pre-Process	Performs pre-processing of the image
3	Best Combination	The best combination is estimated
4	DR stage	Displays the desired DR stage
5.	Exit	Exit the GUI

DEMONSTRATION OF GUI:

This segment exhibits the results of the images, with different DR stages. The database used for testing is of 1500 × 1152 resolution with the magnification factor of 11.6μm

a. DEMONSTRATION OF GUI FOR THE IMAGE WITH NORMAL STAGE OF DR [NO DR]:

The results shown in fig 3 displays the image with Normal Condition [No Diabetic Retinopathy]

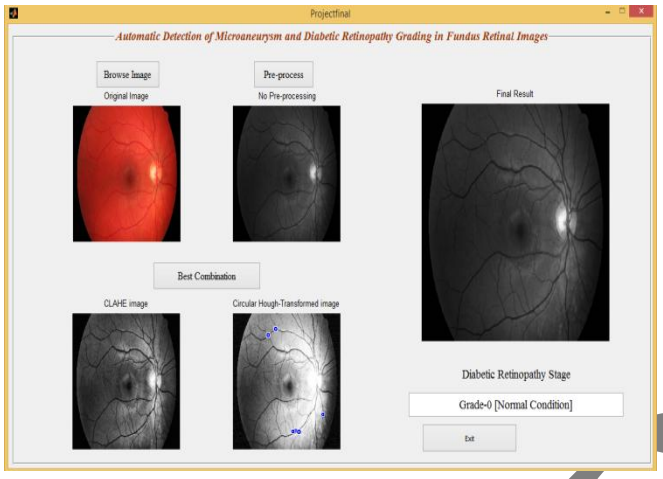

Figure 3: Final result of the image with Normal Condition [No Diabetic Retinopathy]

b. DEMONSTRATION OF GUI FOR THE IMAGE WITH MILD STAGE OF DR [MICROANEURYSM]:

The results shown in fig 4: displays the image with Mild Condition [Microaneurysm]

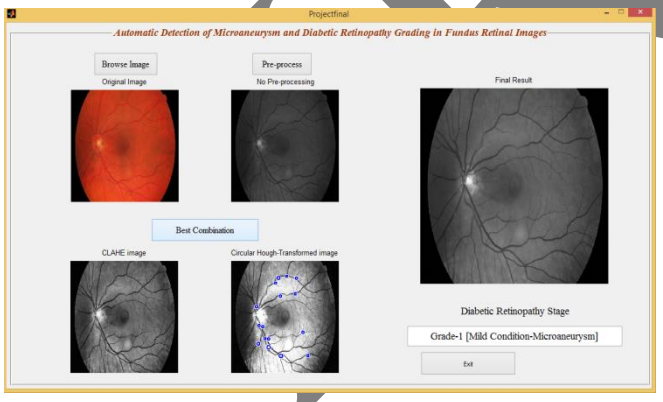

Figure 4: Final result of the image with Mild Condition [Microaneurysm]

c. DEMONSTRATION OF GUI FOR THE IMAGE WITH MODERATE STAGE OF D [HAEMORRHAGES]:

The results shown in fig 5 displays the image with Moderate Condition [Haemorrhages]

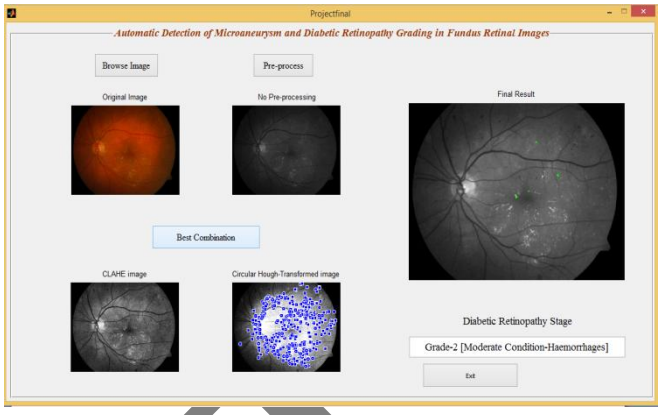

Figure 5: Final result of the image with Moderate Condition [Haemorrhages]

d. DEMONSTRATION OF GUI FOR THE IMAGE WITH SEVERE STAGE OF DR [HARD /SOFT EXUDATES]:

The results shown in fig 6 displays the image with Severe Condition [Hard/Soft Exudates]

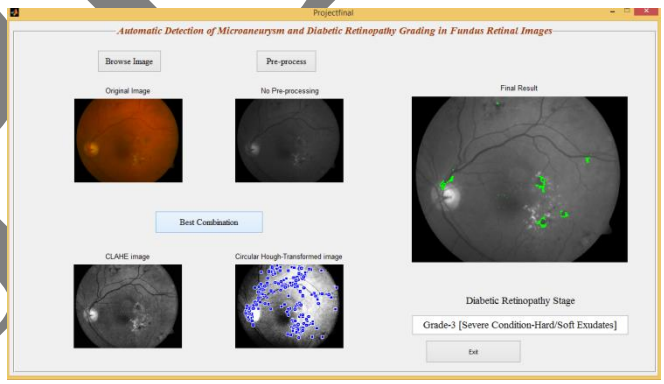

Figure 6: Final result of the image with Severe Condition [Hard/Soft Exudates]

CONCLUSION:

An efficient framework for early detection of Diabetic Retinopathy has been developed. The work concentrates on microaneurysm detection from diabetic retinopathy patient's non-dilated pupil digital images. Hence there is no necessity of dilating the pupil of the patient or carry the FFA process in order to detect the MAs. This system introduces an approach, which improves microaneurysm detection using multiple algorithms. Namely, a framework has been established to find a collection of pre-processing methods and candidate extractors which outperforms the individual algorithms in the number of correctly recognized microaneurysms. An entropy function helped to estimate an optimal subset of [pre-processing method and candidate extractor], which serves to promote the process of testing. CLAHE and Circular Hough

Transform, proved to be the best possible ensemble, based on the highest entropy value. This method also aims to keep the number of false detections low.

The results obtained showed that the ensembles obtained by the proposed framework outperform the state –of –the art candidate extractors in terms of the specificity, sensitivity and accuracy. This system intends to help the ophthalmologists in the diabetic retinopathy screening process to detect the symptoms faster and more easily.

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