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An algorithm for the detection of Diabetic Retinopathy, Maculopathy and performing human authentication

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***Abstract*— Diabetes when effects the eye, results in diabetic retinopathy which intern results in maculopathy. An automated graphical approach has been suggested to detect the Diabetic Retinopathy (DR) and Diabetic Maculopathy (DM) simultaneously by identifying microaneurysms and exudates respectively at the early stage. Microaneurysms (MA) and exudates are the found out by feature extraction process. Depending upon the presence of microaneurysms, the different stages of retinopathy are identified as mild, moderate and severe condition. Human authentication is performed based on the blood vessel pattern matching. This approach is tested over DRIVE, HRF, DIARETDB0, and DIARETDB1 databases and expected results are obtained.**

***Index Terms*— Diabetic retinopathy, Diabetic Maculopathy, Authentication, Microaneurysms, Exudates**

I. INTRODUCTION

Diabetic Retinopathy (DR) and Maculopathy are the defamatory eye disease caused due to diabetes. It may lead to either partial or complete visual loss ability, if it is not diagnosed at the early stages. According to the research scholars it is found that, Microaneurysms, a small red spots are the earliest signs of diabetic retinopathy which appear due to high blood sugar level. Maculopathy which is a result of retinopathy is identified based on the presence of exudates near the macula region. The testing of diabetic patients for identifying Retinopathy and Maculopathy at the early stage can able to reduce the maximum risk of blindness. The ophthalmologists may find difficult to handle large number of diabetic patients especially in rural areas. Hence, an automated detection of DR and DM at the early stage limits the disease severity and helps the ophthalmologists to investigate the disease more properly and timely. Human authentication is a process of confirming the authorization of person which can be performed in number of ways such as by finger print matching, voice recognition, hand writing recognition and so on. Here is a new approach for performing human authentication by matching the pattern of retinal blood vessels.

II. LITERATURE SURVEY

Different methodologies and approaches have been suggested for microaneurysms and exudates detection and also for human authentication based on blood vessel pattern. Blood vessel segmentation by using matched filter response and threshold probing operation is suggested in [1]. Length filtering, matched filtering and thresholding is used in [2] for blood vessel extraction and optic disc is detected by contour method. Computer monitoring system is employed for the detection of dr in [3]. Comparison between reference images and input images predicts the human authentication in [4]. Extraction of blood vessels can be achieved efficiently by using matched filtering, length filtering, image correction and thresholding in [5]. Patient archive and fundus image are used in [6] to detect diabetic retinopathy by using content based image retrieval. A brief review is studied in [7] about different techniques employed in the detection process of microaneurysms, exudates, blood vessel extraction and other retinal infections. Diabetic maculopathy detection and its severity grading based on web system is proposed in [8]. Exudates and blood vessels of various sizes can be accurately detected by using morphological operations as suggested in [9].

Human authentication can be done by properly segmenting the blood vessels and by comparison as put forwarded in [10]. Feature extraction by using discriminative pipelined stages is proposed in [11] to identify the signs and classification of maculopathy. Creation of ensemble to accurately detect the microaneurysms in dr is suggested in [12]. Detection of proliferative dr in [13] is achieved by using major temporal arcade, which is computer based approach. Detection and classification of maculopathy severity levels in [14] is achieved by using multiscale svm. Contrast limited adaptive histogram equalization is used in [15] for the accurate detection of microaneurysms in dr identification. A brief comparison is studied in [16] about various methodologies for human authentication based on blood vessel bifurcation pattern. Grading of maculopathy severity levels in [17] is achieved by extracting some features such as exudates, blood vessels, optic disc and so on. Fuzzy image processing and k- means classifier are employed in [18] for the identification of diabetic retinopathy and maculopathy.

III. PROPOSED DESIGN

The main objectives of the proposed work are:

A. Detection of diabetic retinopathy in retinal fundus image and to classify it as mild, moderate and severe condition.

B. Detection of maculopathy in retinal fundus images

C. To perform authentication based on blood vessel pattern matching.

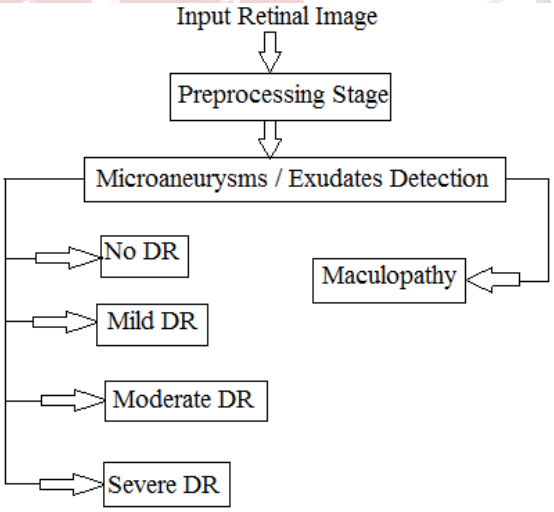


Fig 1: flow of the proposed work

A. Preprocessing stage

The input retinal image taken from the database is subjected to preprocessing technique. In the preprocessing stage, mainly two tasks are carried out. The blood vessels are removed in the first step and in the next step, the optic disc is identified and masked. The reason for the removal of blood vessel is that, there are chances of the interference of microaneurysms which are the small red spots with the blood vessels while identification of retinopathy. The other reason for vessel removal is that, there are also chances of the interference of blood vessel in macula detection process needed for maculopathy detection. It also important to detect and to mask the optic disc. The optic disc is the brightest feature of retinal fundas image. The exudates which indicate the presence of maculopathy are also bright in nature. Hence there are chances of interference of both in maculopathy detection.

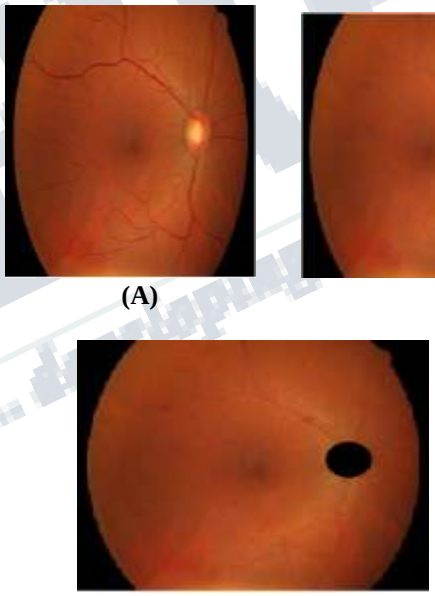
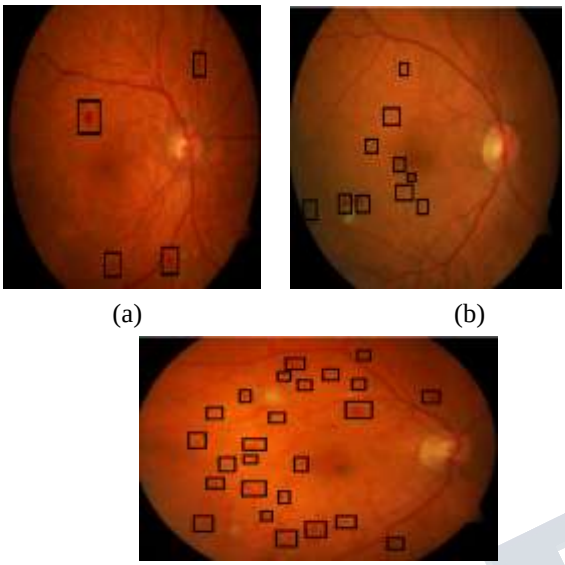


Fig. 2: Preprocessing Stage: (a) Input Image (b) Blood vessels Removed Image (c) Optic disc masked image

B. Detection of Diabetic Retinopathy

The detection of Diabetic Retinopathy starts from the identification of microaneurysms. Microaneurysms are the small red dot like appearance which are the indications of earliest possible recognizable signs of retinopathy. Microaneurysms indicate the damage that has been caused to the blood vessels where the blood is about leak. Usually these circular red spots appear with a diameter between 10 to 100µm but always less than $\lambda<125\mu m$. The feature extraction can be used to detect these small red objects. The Standard Deviation,

Centroid, Median, Variance and Average intensity are calculated for few images. Based on these calculations, SVM technique grades diabetic retinopathy as mild, moderate and severe and healthy conditions.



(a) (b)

(c)

Fig. 3: grading of diabetic retinopathy. (a) mild condition (b) moderate condition (c) severe condition DR

C. Detection of Diabetic Maculopathy

The detection of Diabetic Maculopathy begins with the identification of Exudates and macula region. The macula of the eye can be identified by centroid calculation. The macula which lies nearer to retina is responsible for central vision. Exudates are nothing but the accumulation of fats, proteins and lipids in the retinal image. The damaged blood vessels present near to the macula leak the fatty blood and blocks it which results in blurred or complete loose of vision. When the microaneurysms get matured after some time, they form as exudates. If these exudates are present near to the macula region then the condition is regarded as maculopathy.

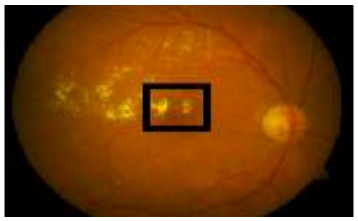
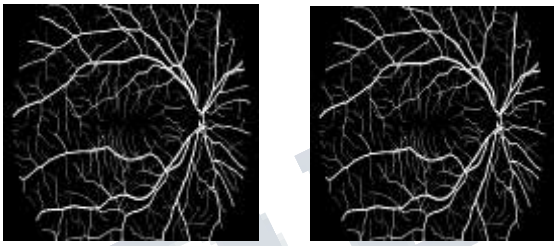


Fig. 4: Retinal fundus image affected by maculopathy

D. Athentication

It also possible to authorize a person by matching the retinal blood vessel which varies from person to person. The blood vessels so removed in the preprocessing stage are compared with the veins that are stored in the database and similarity is calculated by means of Euclidean distance. If the distance is zero, then the particular blood vessel is authenticated, if not the process is vice-versa.



(a) (b)

Fig. 5: Authentication. (a) Vessel extracted. (b) Vessel stored in database.

IV. IMPLEMENTATION

The presented algorithm to detect and to classify the stages of diabetic retinopathy, maculopathy and authentication is tested over drive, hrf, diaretdb0 and diaretdb1 databases. The testing is implemented in matlab version 2013.

Experimental Results and Analysis

In this section, the results of the proposed algorithm are discussed. Here, the input retinal images are subjected to the pre-processing where the removal of blood vessels and masking of optic disc takes place followed by the identification and classification of diabetic retinopathy, detection of maculopathy and authentication which is performed based microaneurysms, exudates identification and vessel patteren matching respectively. The images of drive, hrf, diaretdb0 and diaretdb1 are tested using the proposed algorithm. The 228 different images are considered from the databases. Out of 228, 188 images are made authenticated. The different stages of diabetic retinopathy, detection of diabetic maculopathy and human authentication results are shown using gui.

Fig. 6: gui representation of the result

V. CONCLUSION AND FUTURE SCOPE

The proposed algorithm concentrated on feature extraction process for the microaneurysms and exudates detection for retinopathy and maculopathy identification in patient's retinal images. The proposed work intends to give an aid for the ophthalmologists in the diabetic retinopathy screening process in order to detect the symptoms much faster and better without any doubt. The algorithm worked well with the datasets taken and expected outcomes are obtained. It is also possible to improve the feature extraction process for the detection of microaneurysms and exudates and also vessel extraction for performing authentication.

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