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Automatic Diabetic Retinopathy Prognostic from Optic Imaging Technique: A Review

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***Abstract*— In recent years, there has been a significant increase in the number of diabetic patients with diabetic retinopathy (DR). Diabetic retinopathy is the most chronic eye disease provoked by diabetes problems, which affects the eye when the blood vessels in the retina swell and fluid leaks, sometimes blocking blood flow and obstructing blood from passing through that results atypical new blood vessels grow on the retina. All of these changes gradually lead to vision loss or blindness. The intension of this paper is to review certain researches that automatically diagnose the diabetic retinopathy with different methodologies with distinct precision. In the field of medical science; it is required to diagnose the decease precisely because it may reflect the human's lives severely.**

***Keywords*— Automatic Diabetic Retinopathy Detection, Fundus Imaging, Optic Disc, Optic Cup, CNN, Retinal Image, Hemorrhages.**

I. INTRODUCTION

Nowadays; digital image processing is a vast and demanding area in the field of medical science for detecting various diseases in easy and efficient manner. Detecting Diabetic retinopathy is a challenging task, which is usually handled by Ophthalmologist and diagnosis is done by manually. Manually identification can lead human error and results are hard to reproduce whenever necessary. The intention of various researches is to detect Diabetic Retinopathy automatically that support ophthalmologists to screen their patients and to do clinical study as well which eliminate human error and processing time such results can be reproduced easily whenever needed.

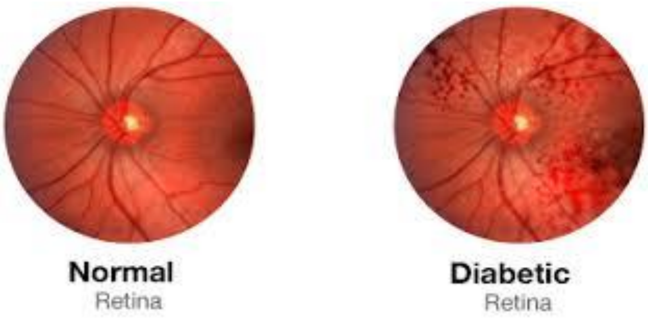

Fig. 1. Impairments over Ratinal Image [1]

The structure of the blood vessels in the retina of the eye provides information about the changes that occur after these retinal related eye diseases. Vascular, fova and optic disc (OD) are used to diagnose certain eye symptoms, such as diabetic retinopathy (DR) and other eye diseases. Many screening tools can be accessed to determine DR manually. Digital fundus cameras are used to take pictures of retinal vessels; therefore, unwanted brightness, environment and fundus image acquisition process can degrade the image quality somewhat. So image enhancement is always necessary to improve the desired image quality. Researchers suggest some methods to improve the quality of retina images. Some image processing methods used by researchers to diagnose eye diseases, including image enhancement, fragmentation, feature extraction and classification. Image recording is used to detect changes in medical images. Different images taken from different angles are arranged in a single coordinate system for successful registration. Image fusion is used to combine different types of information from different images into a single image. Separation is used to divide an image into multiple areas based on color, intensity, and objects. Image classification is used to label a group of pixels based on gray values or other parameters. Image analysis is used to easily understand the content of an image.

Fig. 2. Diabetic Retinopathy vision loss [2]

The structure of the blood vessels in the retina of the eye provides information about the changes that occur after these retinal related eye diseases. Vascular vascular, fova and optic disc (OD) are used to diagnose certain eye symptoms, such as diabetic retinopathy (DR) and other eye diseases. Many screening tools can be accessed to determine DR manually. Digital fundus cameras are used to take pictures of retinal vessels; Therefore, unwanted brightness, environment and fundus image acquisition process can degrade the image quality somewhat. So image enhancement is always necessary to improve the desired image quality. Researchers suggest some methods to improve the quality of retina images. Some image processing methods used by researchers to diagnose eye diseases, including image enhancement, fragmentation, feature extraction and classification. Image recording is used to detect changes in medical images. Different images taken from different angles are arranged in a single coordinate system for successful registration. Image fusion is used to combine different types of information from different images into a single image. Separation is used to divide an image into multiple areas based on color, intensity, and objects. Image classification is used to label a group of pixels based on gray values or other parameters. Image analysis is used to easily understand the content of an image. Diabetic retinopathy often has no warning signs. Even macular edema, which causes rapid vision loss, may not have warning signs for a while. However, in general, a person with macular edema is more likely to have blurred vision, which is difficult to read or drive. In some cases, daytime vision may improve or worsen. In the first stage, there are no symptoms known as non-proliferative diabetic retinopathy (NPDR). Patients may not notice signs and have 20/20 vision. The only way to detect NPDR by direct or indirect ophthalmology of a trained ophthalmologist is to use fundus photography as an objective documentation of fundus results, in which micronarism (blood-filled bulbs in the arterial walls) can be seen. . If vision is impaired, fluorescein angiography can clearly show that the retinal blood vessels are narrowed or blocked (lack of blood flow or retinal ischemia). Macular edema, in which blood vessels and their contents flow into the macular region, can occur at any stage of NPDR. Features blurred vision, dark or distorted images. Ten percent (10%) lose vision associated with diabetes macular edema. Optical coherence tomography shows areas of retinal hardening as fluid accumulates from macular edema. In the second stage, abnormal new blood vessels (neovascularization) form behind the eye as part of diffuse diabetic retinopathy (PDR); These new blood vessels are so weak that they can rupture and cause bleeding (vitreous hemorrhage) and blurred vision. When this bleeding first occurs, it may not be very severe. In most cases, it leaves scars of blood or floating spots on a person's visual field, although the spots often disappear after a few hours. These scars may bleed heavily over a period of days or weeks, making vision blurred. In extreme cases, a person can tell light only from the darkness of that eye. It can take anywhere from a few days to months or years to clear the inside of the eye and in some cases the blood may not clear. This type of bleeding occurs more than once, often during sleep. On fundoscopic examination, a physician will look for cotton wool stains, inflammation-ups (similar lesions caused by the alpha-toxin of Clostridium pain) and dot-blot bleeding.

II. RELATED WORKS

A. Related Works

KK Palavalasa et al. [3] et al. proposed a new method to detect hard exudates with high accuracy relative to the level of injury. In the present method, we first identified candidate exudates lesions using the background ground reduction method. Following the next steps, in the final step of the algorithm, we removed the false exudates lesion results using the de-correlation stretch based method. We tested our algorithm in the publicly available DirectDB database, which contains the basic truth of all images. Compared to current art techniques, we have achieved high performance results for hard exudates lesion level detection with a sensitivity of 0.87, a F7 score of 0.78 and a positive rating of 0.76 (PPV).

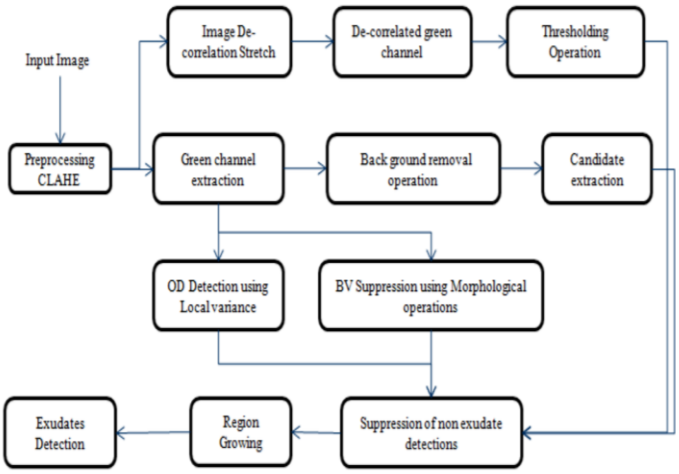

Fig. 3. Block diagram of proposed algorithm [3]

Ravishankar et.al. [4] proposed a new method to locate the optic disc, where they first identified the major blood vessels and used their division to determine the approximate location of the optic disc. Blurred C-Media Clustering tested several classifiers, including SVM, neural networks, PCA, and general Bayesian classification. Refers to the new control to identify the optic disc, where the major blood vessels are located and the approximate position of the optic disc using their division. It is further localized using color features. We show that many features such as blood vessels, exudates, micro aneurysms and bleeding can be accurately identified with various mutations that are appropriately applied. Optical disk localization has a success rate of 97.1%, sensitivity of 95.7% and 95.2% and 90.5% microforma 90.5% microforms respectively. These compare favorably with existing systems and provide an actual prototype of these systems.

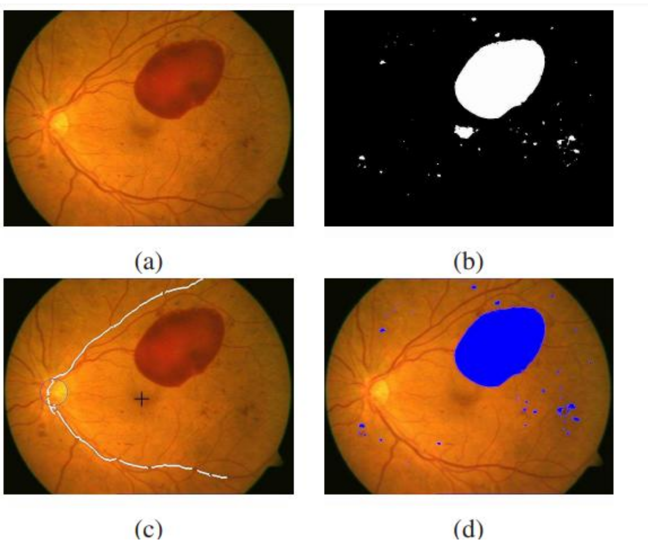

Fig. 4. Illustration of the steps of our Microaneurysms and Hemorrhages : (a) An image from our dataset, (b) The image R obtained after morphological filling, (c) Fovea detection marked with '+', the main blood vessel, (d) The final result after removing fovea [4]

GG Gardener et al. [5] used a back propagation neural network. Exudates area, vascular area, hemorrhage, edema and microanurism area were selected for identification. This was done by analyzing images of one hundred and forty-seven patients with DR and thirty normal retinal images with exudates, retinal images with bleeding or microanurism, retinal images with no blood vessels, and retinal images containing blood vessels. The resulting specificity and sensitivity values are 88.4 and 83.5, respectively.

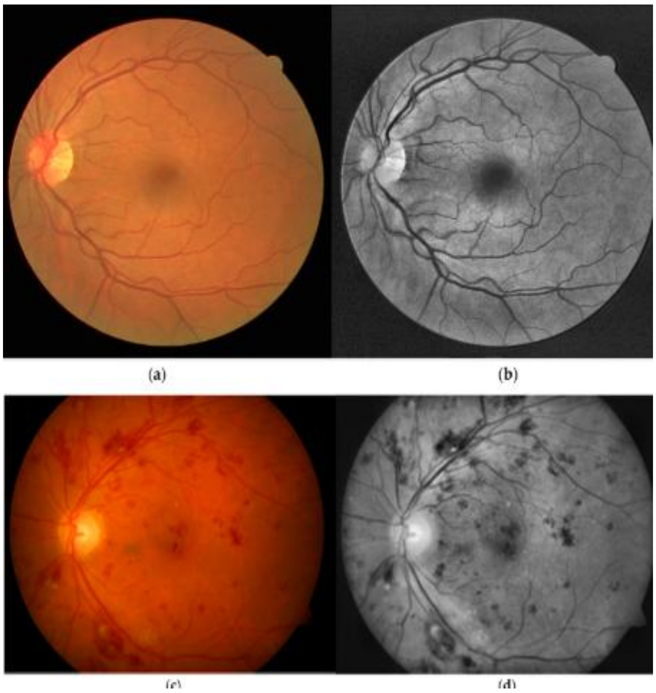

Fig. 5. (a) Original healthy retinal image from the DRIVE dataset; (b) Enhancement of image (a) using CLAHE; (c) Original diseased retinal image from the DIARETDB0 dataset; (d) Enhancement of image using CLAHE [5]

Alireza et al. [6] proposed a partition based on the color representation of the Loves color space and its integration with the best partition using Fuse C-Medium (FCM) clustering. They used retina color information for our goals and showed progress through gray scale based technologies. FCM clustering gave an accuracy of 85.6%, a sensitivity value of 97.2 and a specificity of 85.4.

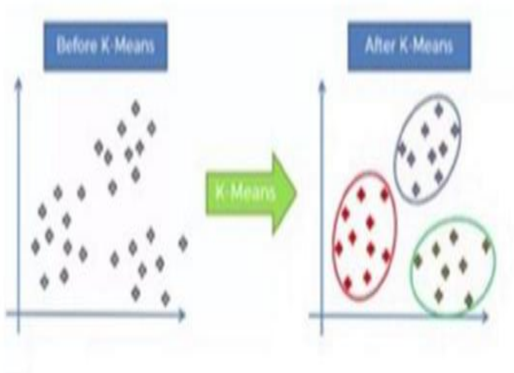

Fig. 6. K-means clustering principle [6]

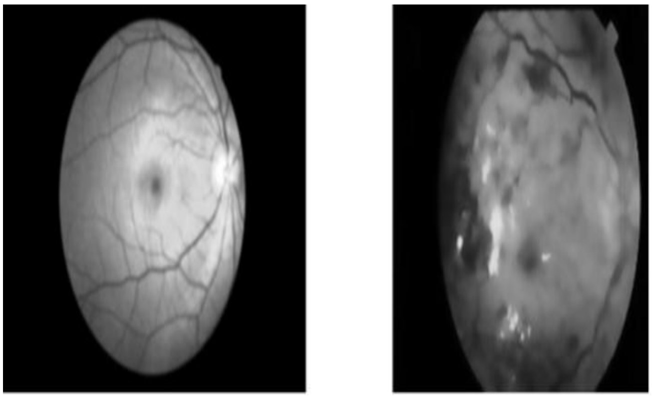

Fig. 7. Segmentation implementation [6]

A. Mukherjee et al. [7] proposed a supervised learning method to divide a given set of images into 5 classes. Various image processing methods and terslters improve many important features, such as the neural use for classification and the automatic, adaptive and innovative approach to image processing and the retina damage that can be easily detected at an early stage.

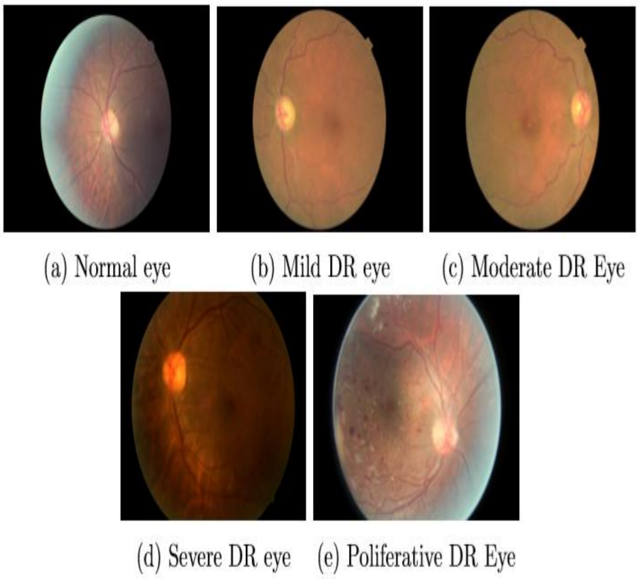

Fig. 8. System Diagnosis Phases [7]

M.W.Khan et al. [8] proposed a work of using several image processing techniques for DR injury detection. Early diagnosis of DR has been found to reduce the risk of vision loss by up to 50%. The image processing methods discussed in this paper can accurately identify DR. The hybrid method should be used to get the best results considering the accuracy and efficiency of DR identification. The various legion detection methods used for DR also give appropriate results. Image processing methods are evaluated based on these results.

III. PROBLEM IDENTIFICATION

System uses background and foreground subtraction for masking the unwanted background. It also uses thresholding for segmentation that segments blood vessels by converting it into binary image. But if eliminating or masking has been done using binarization or black and white intensities value then sensitive information may also erode or eliminate from image that may degrade the correct recognition rate. Back ground region of the fundus is the portion of the image where no retinal anatomy or lesions present, it consists of only the retinal layer of the fundus so it is an unwanted portion of the fundus image for screening of the DR. The detection of any anatomy or lesion present on the fundus image becomes simple, if it can detect and subtract the back ground region from the fundus image. By removal of back ground information we are left with only the retinal anatomy and lesions on the fore ground image of the fundus.

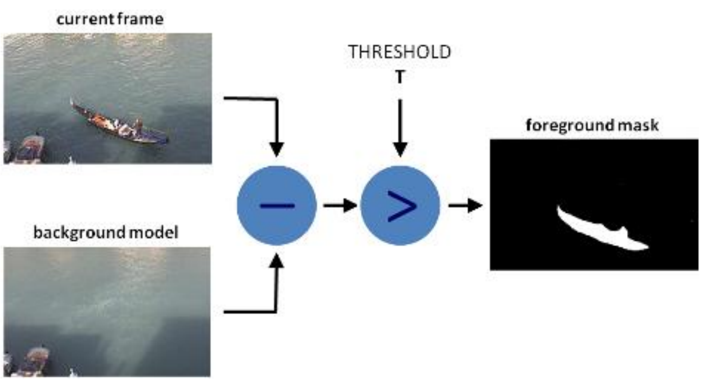

Fig. 9. Background Subtraction [12]

A major task in the field of computer vision and image processing is to detect the foreground and detect changes in image sequences. Background minimization is any technique that allows you to take the front of the image for further processing (image recognition, etc.). Most applications do not require information about the evolution of motion in a video sequence, but only information about changes in the scene, because the areas of interest on an image are objects in front of it (humans, cars, text, etc.). Object localization is required after the image preprocessing phase (which may include post-processing such as image denominating and syntax) that can use this technology. Based on these changes in the foreground, spotting the foreground separates the background from the background. These are techniques that analyze video footage recorded live with a still camera. It works well for object recognition from a general background that does not have complex features. It does not work effectively when it contains useful information in the background, such as blood vessels or nerves that are directly proportional to the accuracy of the system. Diabetic retinopathy requires in-depth monitoring to make a proper diagnosis with prudence and a high level of accuracy in the blood vessels. Diabetic retinopathy is a disease of the retina that affects diabetics and is a leading cause of blindness. It is a disease in which the blood vessels in the retina swell. It can damage the retina of the eye and lead to blindness if the level of diabetes is too high. Diabetic retinopathy affects 80% of people with diabetes for 20 years or more. With proper treatment and eye monitoring, at least 90% of new cases can be reduced. The more diabetic a person is, the more likely they are to develop diabetic retinopathy. It is a leading cause of blindness in people between the ages of 20 and 64 years. The most effective treatment for the prevention of these eye diseases is early detection by regularly testing the fundus to identify the early symptoms of diabetic retinopathy. The digital fundus camera in ophthalmology gives us digitized data, which can be used to automatically diagnose the disease. Diabetic retinopathy is an eye disease that causes partial or complete loss of vision. Examining these images automatically will help doctors to more accurately diagnose the patient's condition. It emphasizes the determination of retina images using appropriate image processing and data mining techniques.

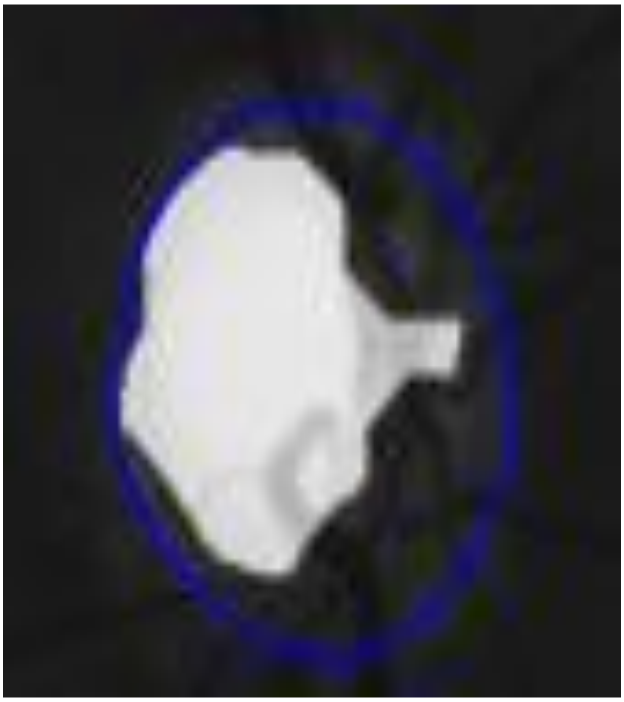

Fig. 10. Erosion by Segmentation [6]

IV. CONCLUSION & FUTURE SCOPE

Automatic diabetic retinopathy detection provides the best solution to the difficulties and shortcomings of the current manual approach to detecting diabetic retinopathy with the naked human eye, which is time consuming and requires more effort and human resources with expert level knowledge and experience. There has been a lot of research done so far on the classification of diabetic retinopathy, but masking is a big issue that somehow directly destroys accuracy. An excellent system can be implemented with a Sobel Edge Detection and some pre-processing techniques to detect diabetic retinopathy with a high degree of accuracy. The system is not just about dividing the spot and blood vessels; this increases image intensity and effectively dissociates visual diabetic retinopathy and allows repetitions to lead to greater accuracy than ever before.

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