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A Systematic Review on Diabetic Retinopathy Detection Methods

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Abstract: ***In current era Diabetic retinopathy (DR) has become a very common eye disease in most of the countries. It almost occurs in 80% of all diabetic patients and which cause and leads to blindness. In DR Diabetic macular edema (DME) is an advanced symptom of diabetic retinopathy and which can lead to permanent vision loss. So automatic evaluation of macular edema is increased and it is important. In this paper we have proposed and done a survey on the different techniques used for detection of macular edema in DR. It helps the ophthalmologists for proper treatments that might be help to eliminate the disease or to decrease the severity of it. DR is composed of a characteristic group of lesions, fovea, optical disc found in the retina of individuals which suffered from diabetes form several years. Detection of the exudates in early stage can prevent vision loss and damages. Many approaches have been proposed and developed for the analysis of macular edema.***

Keywords: Diabetic retinopathy, Diabetic macular edema, Exudate.

I. INTRODUCTION

In Diabetic Retinopathy (DR) blood vessels in the retina of diabetic patients begin to leak from the macula, hence it is responsible for vision of eye centrally. These leaks may leads and cause the macula to become thick and swell, successively distorting cause poor vision and further lead to blindness. In Surveys it's estimates that around 2.8 million people in country affected by DME and approximately 300000 new cases occurs annually. Diabetic macular edema is a major cause of vision loss in people having diabetic retinopathy. People with diabetes have a 10 percent of risk for developing the condition during their lifetime. The growing incidence of diabetes, the high cost of examinations and due to the lack of specialists increase the work load of physicians and further prevent many patients from receiving effective treatment. Automatic detection of clinical signs of diabetic retinopathy can help ophthalmologists in the diagnosis of the disease automatically with the subsequent cost and time savings. Early detection of the retinopathy disease through regular screening is important as they don't show any symptoms in most of the cases. So there is need of automatic assessment of DME is essential. This paper discusses and focuses on the different approach towards the detection of diabetic retinopathy. Color fundus images are used by ophthalmologist's for studying the eye diseases like diabetic retinopathy. Figure 1 shows a normal retinal image and color fundus image labeled with various feature components of Diabetic Retinopathy.

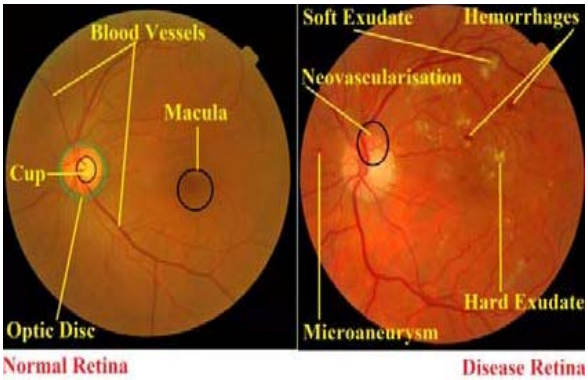

Fig. 1.Normal Retina image and Color fundus image with anatomical structures and lesions annotated.

Hard exudates (HE) are occurred as yellow lipid deposits which appear as bright yellow lesions. The bright circular region from where the blood vessels flow is called the optic disk. The fovea defines the center part of the retina, and is the region of highest visual acuity. The spatial distribution of exudates like soft and hard and micro-aneurysms and hemorrhages, especially in relation to the fovea can be used to determine the severity of DR. Exudate is a fluid with a high content of protein and cells lipids which has escaped from blood vessels and had been deposited in tissues or on tissue surfaces of an eye which get thick. The severity of the risk of edema is evaluated on the base of the proximity of HE to the macula, which is defined to be a circular region centered at fovea and with optic disc (OD) diameter. The risk of DME increases when the HE locations approach the macula, with the risk being the highest when they are within the macula. This is an important factor in DME assessment for further referential to the patients to an expert.

II. Literature Review

Li Tanget. al. [1] proposed novel splat feature classification method to detect retinal hemorrhages based on extracting features like color, spatial location, interactions with neighboring splats, and shape and texture information.. Istvan Lazar and Andras Hajdu [2] used directional cross-section profiles for detecting the micro-aneurysms. Analysis was made on the features like size, height, and shape of each profile. The statistical measures of these feature set is used in a naïve Bayes classification to eliminate spurious candidates**.** Balint Antal and Andras Hajdu [3] suggested novel method by considering the output of multiple classifiers. Micro-aneurysms can be detected by improving pre-processed methods and candidate extractors. K. Sai Deepak and J. Sivaswamy [4] introduced motion pattern technique which is a preliminary technique for detecting the exudates in macula. Gaussian Data Description and Principal Component Analysis Data Description classifiers were used to extract the exudates. L. Giancardo et. al. [5] used multiple view retinal fundus images which are registered for detection and quantitative measurement of the disease. Finally, a dense pyramidal optical flow is calculated to build a naivec height map of the macula. K. Ram et. al. [6] proposed clutter rejection method to detect the Micro-aneurysms (MAs). This method has two clutter rejection stages in which MAs are discriminated from Non-MA by using similarity computation. C. Agurto et. al. [7] developed the novel technique for lesion detection by using instantaneous amplitude and instantaneous frequency characteristics of an image. Keerthi Ram and Jayanthi Sivaswamy [8] proposed multi-space clustering technique to differentiate hard and soft exudates. Alireza Osare et al. [9] recommended a new method that combines computational intelligence and pattern recognition with machine learning techniques to analyze diabetic retinal images. Akara sopharak [10] used FCM clustering technique for detecting the exudates pixels, Wang et. al. [11] used median filter to calculate an intensity difference map and dynamic clustering was used to determine lesion clusters. Then, domain knowledge was applied to identify true exudates. Sai Prasad Ravishankar [12] used morphological process to find exudates and blood vessels but severity level of the diabetic retinopathy was not discussed. J. David Rekha Krishnan [13] proposed thresholding technique to identify the lesions, optic disc and vascular network and neural network classifier was then used to assess the severity level of the disease. Akara Sopharak et. al. [14] used FCM technique for exudates segmentation and morphological methods for reconstruction. Watershed segmentation method was used for segmentation of exudates [15], which needs improvement in distinguishing exudates and optic disc from blood vessels.

The presence of exudates was detected using Fixed and variable thresholds [16]. Atif Bin Mansoor et. al. [17] used Fuzzy Morphology for detecting the exudates. Giri Babu Kande [18] proposed Contour technique for locating the optic disc and weighted FCM was used for segmenting the exudates. Akara Sopharak et. al. [19] used naïve bayes classifier and support vector machine for feature selection and exudates classification.

Apart from excude detection the work is also conducted on eye fundus images whose detail are give as. Blood vessels damaged from diabetic retinopathy can cause vision loss in two ways: Fragile, abnormal blood vessels can develop and leak blood into the center of the eye, blurring vision. This is proliferative retinopathy and is the fourth and most advanced stage of the disease. Fluid can leak into the center of the macula, the part of the eye where sharp, straight-ahead vision occurs, the fluid makes the macula swell, blurring vision. This condition is called macular edema. It can occur at any stage of diabetic retinopathy, although it is more likely to occur as the disease progresses. About half of the people with proliferative retinopathy also have macular edema. Normal Vision and the same scene viewed by a person with diabetic retinopathy. Using the current technology, large amounts of fundus images are collected from the 12 eye-examination with the fundus camera. these images are sent to trained ophthal-mologists for analysis and diagnosis. In order to improve the eficiency of the work process and cost-reduction, there is a demand in the use of computer-based approach to detect diabetic retinopathy stages [26].

Figure2: Example of an eye-examination using fundus camera

Till present, many methods are researched and developed to increase the sensitivity and specificity. Sensitivity refers to the percentage of abnormal fundus images classified as abnormal by the method used [27]. Specificity is defined as the percentage of normal fundus images classified as normal [27]. When these two factors increase, these indicate that the method is better and more accurate. As a result, a computer-aided diagnosis system to detect difierent stages of diabetic retinopathy was developed to assist the ophthalmologists. In the study of 25 fundus images conducted by IQbal, M.I, aibinu,A.M,Gubbal,N.S, khan. A, this system was developed to categorize grade 1 and 2 diabetic retinopathy [27] . With the implementation of equalisation of uneven illumination in the pre-processing stage, the quality of the fundus image improved. Then, k-mean clustering algorithm with two-cluster class centre was carried out in the segmentation stage. Lastly, noisy pixels were removed from the image in the disease classifier stage. From this research, it is able to detect red spots and bleeding successfully with specificity and sensitivity of 98 percentages and 61 percentages respectively. It is to be taken the image pre-processing part from this work shown in thesis, also the work is big and nice but from that one it is to be select only some function that might be better for my application development. In another research, a three-step approach to detect and classify bright lesion in colour fundus image was carried out by XiaoHui, Z., and Chutatape, O[24]. The approach consists of the following 3 steps: the use of local contrast enhancement, improved fuzzy C-means to segment bright lesion and Hierarchal support vector machine for classification purposes. In another research by Vallabha et al [25], the scale and orientation of Selective Gabor filter was used for detection and classification of vascular abnormalities. This is chosen to detect and classify the fundus images into mild or severe case with reference to the output obtained from the Gabor filter. An automated screening system was developed to analyse digital colour retinal images. It involves difierent stages of the non-proliferative DR and proliferative DR class too [20].the algorithm achieved a sensitivity of 90 percent and specificity of 100. A computer system was developed to identify the normal, mild DR,

moderate DR, severe DR and prolific Drin [21] this algorithm demonstrated a specificity of 88 percent and a resulting sensitivity of 82 percent in detecting diabetic retinopathy. Q. Li et al. have proposed a method for screening DR and distinguishing PDR from NPDR automatatically through color retinal images using morphlogical reconstruction in[22]. the algorithm achieved a sensitivity of 80;5 percent and specificity of 90.8 percent. the work proposed by Berrichi Fatima Zohra, Benyettou Mohamednormal for a computer-based system to identify Normal, NPDR and PDR.the system proposed demonstrated a classification accuracy of 95 percent, sensitivity of 97.5 percent and specificity of 100 percent[23].In this work it is taken five texture feature for classification are Contrast & homogeneity along with some algorithmic parameter and fed to the support vector machine (SVM).

III. Discussion

We have discussed the existing approaches and method to detect diabetic retinopathy in the above section. Most of them are based on the retinal images and image processing plays a important role in detection of DR. Diabetes occurs when the level of glucose in the blood is get high above the normal. Over some years diabetes can damage the blood vessels of the retina which cause also called diabetic retinopathy (DR) and is the major cause of poor vision and blindness. If the disease is detected in the early stages, treatment can slow down the progression and which can be prevented. The automatic detection of diabetic retinopathy helps the ophthalmologists for giving better treatment to their patients. Each of the techniques discussed above have both advantages and disadvantages. Detection based on SVM is more recommended. With the SVM and kNN classification will be more accurate.

IV. Conclusion

In this paper we have done a survey on various techniques for diabetic retinopathy and it's proper classification. Diabetic retinopathy is a serious threat for the country in present scenario. Early detection of diabetic retinopathy is very essential and important for prevention of vision loss. In most of the countries, diabetic retinopathy (DR) is a major reason of vision loss. More around 2.8 million people in country affected by DME and approximately 300000 new cases occur annually. Thus the above sections incorporate the existing techniques for the automatic assessment.

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