A Review on the Abnormalities of Diabetic Retinal Images

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Abstract: **In recent biomedical field, ophthalmology has a significant role. In order to identify and detect the pathologies in diabetic retinopathy accurately, and correctly converge on time, it requires computer aided techniques. This paper focuses the various abnormalities of the retinal images and its procedure of the automated techniques involved in it. And also it provides performance analysis in terms of sensitivity and specificity calculations for the various techniques behind the micro aneurysms, exudates and hemorrhages.**

Keywords: Diabetic retinopathy, abnormalities, micro aneurysms, exudates, hemorrhages

1. INTRODUCTION

Diabetic Retinopathy (damage to retina)

The main cause of vision loss is the diabetic retinopathy and its prevalence is set to continue rising. The early detection may be used to encourage improvement in diabetic control. When the small blood vessel in the retina has a high level of glucose, the vision will be blurred. Over a period of time the retina has some abnormalities like microanesysms, exudates and hemorrhages. For the diagnosis, ophthalmologists use color retinal images of a patient acquired from digital fundus camera. Prolonged diabetes causes micro vascular leakage and micro vascular blockage within the retinal blood vessels.

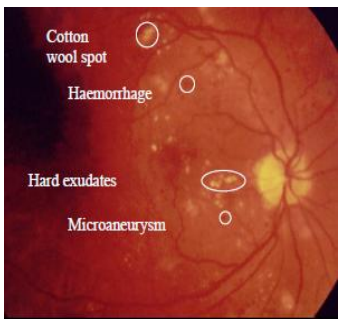


Fig1: retinal image

The literature on the automatic retinal image diagnosing algorithms are classified to the following steps

1. Preprocessing

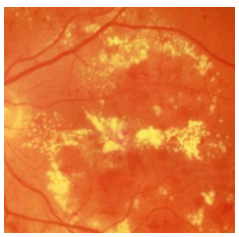
2. Feature Extraction/segmentation

3. Classification

2. LITERATURE

A. EXUDATES:

One of the visible signs. These are extends into the macula area, vision loss can occur. The exudates can be classified as Hard, Soft Exudates; hard exudates (intra retinal lipid exudates) are yellow deposits of lipid and protein within the sensory retina. Soft exudates (cotton wool spots) they are white, fluffy lesions in the nerve fiber layer.



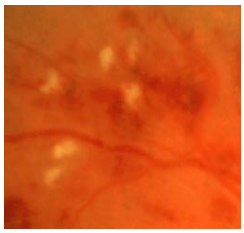


Fig2: Soft Exudates Hard Exudates

TABLE 1

s. no	Title	Author	Preprocessing	Method	Result
1	Automatic tudates tection from abetic tinopathy tinal image ing Fuzzy. C-eans and orphological ethods.	Akara Sopharak, Bunyarit Uyyanonvara.	RGB to HSI Media filtering CLAHE	FCM clustering: 2.Coarse segmentation FCM 3.Fine segmentation Morphological reconstruction	Time taken for running 6 minutes Sensitivity 86% Specificity 99%
2	Hybrid Approach for Detection of Hard Exudates	Dr. H.B. Kekre, Dr. Tanuja, K. Sarode, Ms. Tarannum Parker	Resizing / Green Channel	Clustering: Linde-Buzo-Gray Algorithms	Morphology based approach: sensitivity 91% specificity 39% accuracy 67%, LGB: sensitivity 80% specificity 57% accuracy 68%, K means: sensitivity 77% specificity 76% accuracy 76%,
3	Detection of Exudates for the diagnosis of diabetic Retinopathy	Anitha Somasundaram, and Janardhana Prabhu	RGB - HSV/Medium filtering/ Enhancement	Score computation technique	Not mentioned
4	Localization of Hard Exudates in Retinal Fundus Image by Mathematical Morphology operation.	Mehdi Ghafourian Fakhar, Hamidreza Pourreza	Green channel	morphological/Top operation	Sensitivity 78.28%
5	Detection of Exudates on Diabetic Retinopathy images based on morphological operation and connected component analysis.	M. Ponnibala, S. Mohana Priya	Green channel,/ HE	Morphological connected component	Not mentioned
6	Fine Exudates Detection using morphological Reconstruction Enhancement	Akara Sopharak, Bunyarit Uyyanonvara.	Resizing /RGB to HIS/CLAHE	Morphological Reconstruction	Morphology: Sensitivity 88.1% Specificity 99.2% Accuracy 99%, Fem: Sensitivity 97.2% Specificity 85.4% Accuracy 85.6%
7	Exudates Dynamic Detection in Retinal Fundus images based on the Noise map distribution	Ivo Soares, Miguel castelo Branco	Green channel	Morphological operators and adaptive thresholding	Sensitivity 97.49% Specificity 99.95% Accuracy 99.91%
8	Automatic optic Disc Detection and Removal of false Exudates for Improving Retinopathy classification Accuracy	G.Ferdic Mashak Ponnaiah, Capt.Dr. S.Santhosh Baboo	Genetic Algorithm	Baseline method	Not mentioned
9	An Effective Frame work for Automatic Segmentation of Hard Exudates in Fundus Images	Nan Yang, Hu Chaun Lu	Green channel/ CLAHE	Boosted soft Segmentation/Background Subtraction	Sensitivity 99.64% Specificity 87.86% Accuracy 93.78%
10	Detection of Hard Exudates using Simulated Annealing based Thresholding Mechanism in digital retinal fundus image	Diptonee l Kayal and Sreeparna Banerjee	Grayscale/Median filter/Image Subtration	Simulated Anealing/Thresholding	Sensitivity 98.66% Predictivity 98.12%
11	Computerized Exudates Detection in Fundus Images using statistical	Sidra Rashid	CLAHE Clustering	Fuzzy clustering (FCM)	Not mentioned

	feature based Fuzzy c-mean clustering				
12	Comparative Exudates classification using Support vector machines and Neural networks	Alireza Osareh, Majid Mirmehdi	Green channel	SVM/NN	SVM: Sensitivity 83.3% Specificity 95.5%
13	A Segment based Technique for detecting Exudates from Retinal fundus image	Atul Kumar, Manish Srivastava, A.K. Sinha	Resizing /Color normalization green channel/ noise removal/ AHE	Morphological/Matched filter/SVM	Sensitivity 97.1% Specificity 98.3%
14	Neural Network based detection of hard exudates in retinal images	Maria Garcia, Clara I. Sanchez	Green channel contrast enhancement	Neural network MLP RBF SVM	MLP: Sensitivity 100% Specificity 92.59% RBF: Sensitivity 100% Specificity 81.48% SVM: Sensitivity 100% Specificity 77.78%
15	Automatic detection of Exudates in diabetic Retinopathy Images	Kittipol Wisaing, Nualswat	HIS/contrast enhancement	Binary segmentation FCM clustering	Sensitivity 96.7% Specificity 71.4% Accuracy 79%
16	Automated Detection of Exudates in retinal Images using Split And Merge Algorithm	Hussain F.Jaafer, Asoke .Nandi	green channel	Split and merge	Sensitivity 89.3% Specificity 99.3% Accuracy 99.4%

B MICROANEURYSMS

The diabetes key lesion is microanesysms. These are the focal dilatations of retinal capillaries, the diameters of 10 to 100 microns and appear as red dots.

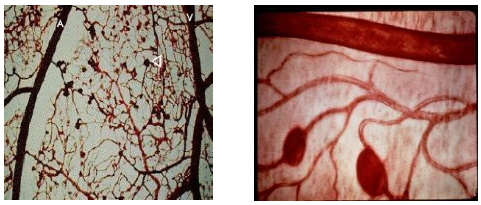


Fig3: microaneurysns

TABLE II

s. no	Title	Author	Preprocessing	Method	Result
1	Automatic Microaneurysm Quantification for Diabetic Retinopathy screening	A. Sapharak, B. Uyyanonvara and S. Barman	Green channel/ CLAHE	Feature Extraction/Naïve Bayes classifier	Sensitivity 99.99% Specificity 83.34% Accuracy 96.5%
2	Automatic Microaneurysm Detection and Characterization through Digital color Fundus image	C.I.O Martins, R.M.S Vesas, G.L.B Ramamhi	Green channel/ BG Subtraction/MA	Detection segmentation feature extraction classification	Accuracy 84%
3	Detection and classification of Microaneurysm for Diabetic Retinopathy	J. Prakash, K. Sumathi	CLAHE	Top hat Transform/Multiple Gaussian Masks	Not mentioned
4	Identification and Classification of Microaneurysm for early detection of diabetic retinopathy	M. Usman Akram, Shehzad Khalid, Shoab A. Khan	Green channel. Smoothening by morphological opening	Feature extraction/hybrid classifier	Sensitivity 98.64% Specificity 99.69% Accuracy 99.40%
5	Automated Detection of Microaneurysm using Robust Blob Descriptors	K. Adal, S. Ali, D. Sidiqe	Green channel/ SVD	Hessian operator	Sensitivity 44.64%
6	An algorithm for identification of retinal Microaneurysm	A. Shaeidi	Illumination normalization contrast enhancement	Feature extraction classification -NN	Sensitivity 98.5% Specificity 96.9% Accuracy 97.7%
7	Detection of Microanesysms in Retinal Angiography Image using the circular Hough	Sekineh Asadi Amiri, Hamid Hassanpour	Red free image	Hough transform/Circular	Accuracy 88.5%

	Transform				
8	Automatic detection of Diabetic Retinopathy in Non Dilated RGB Retina; Fundus Images	Sujith kumar S.b., Vipula Singh	Green/Gray scale/Contrast	Feature extraction/Classification enhancement	Sensitivity 94.44% Specificity 87.5%
9	Automated Microaneurysm detection method based on double-ring filter in retinal fundus images	Atsushi Mizutani, Chisako Muramatsu	Green channel/ double ring filter	Feature extraction/classificlassifier	Rule based classification 170/336, ANN 151/336
10	Identification of diabetic retinopathy stages in human retinal images.	A.Alaimahal, Dr. S. Vasuki	Green channel/ CE/Median filter	Extended minima transform	Sensitivity 98.89% Specificity 89.70%
11	Automatic Microanesysms detection from Non-dilated Diabetic Retinopathy Retinal Images	Akara Sopharak, Bunyarit Uyyanon vara	Green channel/ Median filtering. CLAHE	Extended minima transform	Sensitivity 81.61% Specificity 99.99% Accuracy 99.98%
12	Algorithm for detection Microaneurysm in low resolution color retinal images	G. Yang, L. Gagnon, S. Wang	Green channel	Morphological filtering/Top hat transform. Thresholding /Classifier	Sensitivity 90%
13	Microaneurysm Detection in color fundus images	Lee Streeter and Michael J. Cree	Green channel/ Shade correction	Region growing/Feature extraction classifier	Sensitivity 56%
14	Automatic Identification and Classification of Microaneurysm for Detection of Diabetic Retinopathy	R. Gowthaman	Denoising/Enhancement	Feature extraction, SVM classification, ELM (extreme learning machine)	Sensitivity 95.74%. Sensitivity: DRIVE SVM is 95.74% ELM is 97.87%. Diaretdbi, SVM is 91.12% ELM is 94.08% Specificity: DRIVE SVM is 95.89% ELM is 97.94%.
					Diaretdbi, SVM is 95.43% ELM is 98.34%
15	Internal Components Combination to Detect Microaneurysm	Md. Muhid Ahmed, Dr. K. Kumaravel	Grayscale/ CLAHE	Circular Hough Transform	Sensitivity 88%
16	Micro aneurysms detection Methods in retinal Images using Mathematical morphology	Murugan.R,Reeba Korah	Green chennal	Extended minima Transform,TOPHAT,naïve Bayes classifier	Not mentioned

C HEMORRAGHES

When the wall of a capillary is weakened, it may rupture giving rise to an intra retinal hemorrhages. Usually it is round or oval (dot or blot). Dot hemorrhages appear as bright red dots and are same size as large MAs. Blot hemorrhages are larger lesions they are located within the mid retina and often within or surrounding areas of ischemia.

Fig4: hemorrhages

TABLE III

S. No	Title	Author	Preprocessing	Method	Result
1	Automatic detection of microanuresysms and the Hemorrhages in digital fundus Images	Giri Babu Kande, T. Satya Savithri	Green channel/Red channel/histogram matching	Morphological top hat /SVM classifier	Sensitivity 100% Specificity 91%
2	Automatic detection of microanuresysms and the Hemorrhages in color eye fundus images	Sergio Bortolin Junior and Danner Welfer	Resizing/ green channel/ contrast enhancement CLAHE	Morphology generation	Sensitivity 87.69% Specificity 92.44%
3	Detection of retinal Hemorrhages	Athira R.V. Ferlin	Mean color Backgrou	Splat feature extraction/	Not mentioned

	using splat feature classification techniques	Deva Shahila D	nd/ gradient operators	watershed segmentation KNN classifier	
4	Improvement of automatic hemorrhage detection methods using brightness correction of fundus images	Yuji Hatanaka, Toshiaki Nakagawa	RGB to HSV	Bright correction method	Sensitivity 80% Specificity 80%
5	Splat feature classification with application to Retinal Hemorrhage Detection in Fundus images	L. Tang M. Niemeijer, J.M. Reinhasdt	RGB	Splat feature extraction wrapper approach	Sensitivity 96%
6	Detection of Hemorrhages' in retinal images	V. Vijayakumari	Contrast stretching/ median filtering	Morphological operation/ cellular NN	Sensitivity 91.7% Specificity 99.9%
7	Classification of hemorrhages pathologies on digital fundus images using a combination of neural network and tracking algorithms	S.A. Barman, C. Sinthanayothin	RGB image	Multi-perception back propagation / matched filter	Efficiency 100%
8	Improvement of Automatic Hemorrhages Detection methods using shapes recognition	Nidhal Khdhair EI Abbadi	RGB to Gray	Thresholding	Sensitivity 80.37% Specificity 99.53%
9	Automatic detection of Microaneursysm and Hemorrhage for screening of retinal diseases	Tareq AI Saeed, Doaa Youssef	Gray level/ frequency domain filtering	Morphological reconstruction	Not mentioned
10	A survey on usage of Data Mining Techniques in the Detection of Hemorrhages in Fundus Images	Deepa D, Sumathi P	Noise removal/contrast enhancement	Candidate Extraction/ KNN classifier	Not mentioned
11	The role of Hemorrhages and exudates detection in automated grading of diabetic retinopathy	Alan D. Fleming, Keith A. Goatman	-	-	Not mentioned

D. PERFORMANCE ANALYSIS

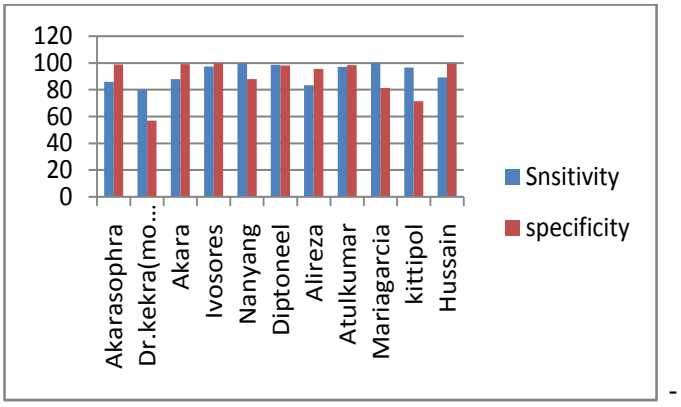


Fig5: Exudate analysis

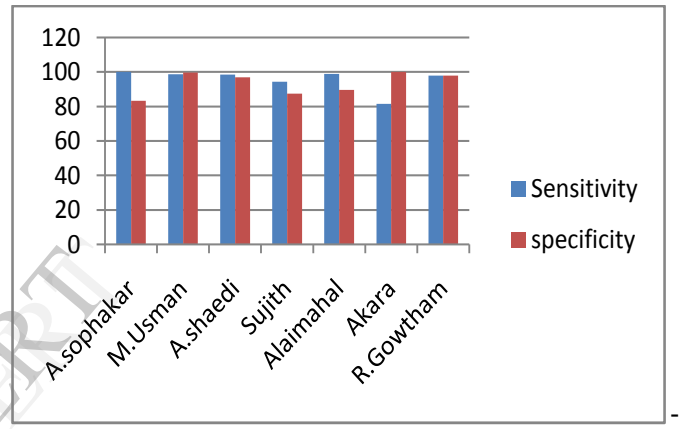


Fig6.Microaneurysms Analysis

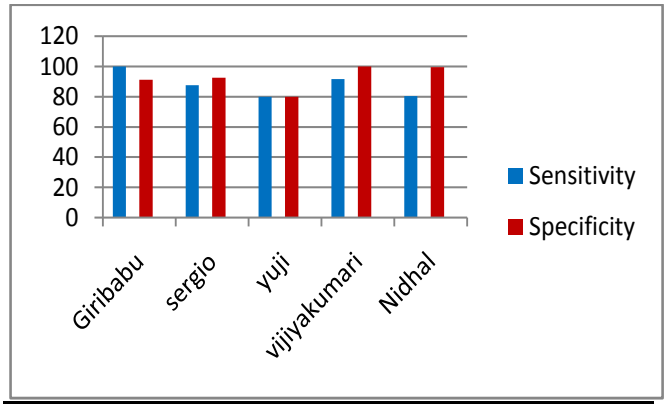


Fig7: hemorrhages

E .CONCLUSION

This Paper will give the idea about the Automatic analysis of Diabetic retinopathy which affects the vision. From this, the new authors can get the understanding about the Automatic Screening and detection of various lesions at the early stage,

and it will give the preventive measures to the blindness. The summary will give the performance analysis of the authors of various Universities also.

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