Survey Paper for Diabetic Retinopathy Detection Techniques

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***Abstract*—**The main reason for the blindness in the world is Diabetes. Diabetes is a worldwide disease, when it is not taken seriously, it results in blindness. Many efficient algorithms to detect the Diabetic Retinopathy are elaborately surveyed, i.e., identification of hemorrhage in the retina. Many algorithms are established to detect the DR. We have evaluated some of the efficient algorithm which is estimated by their working and this paper gives the detailed explanation of algorithms which works on the detection of hemorrhage.

Keywords- *AM-FM (amplitude modulation-frequency modulation), ASF(Alternative Sequential Filtering), ODS (Optical Disk Segmentation).*

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I. INTRODUCTION

To evaluate the working of an efficient algorithm is a challenging task. Here we have taken some of the efficient algorithm which works on the detection of diabetic retinopathy. These algorithms are surveyed in accordance with their working. CAD algorithm works inspecting the lesion in the color fundus image and deploys fusion technique. In the multiscale AM-FM (amplitude modulation-frequency modulation) method it works by comparing the normal image and pathological retinal image and detects the presence of hemorrhage. Two stage methodology works on the global characterization approach and asymmetric rotation. An ensemble based method works with the histogram evaluation and equalization. Optical disk segmentation employs by saturation of red and bright lesion regions. Visual Dictionary uses analytical approach by estimating POI and ROI of image. Splat based classification approach works partitioning into non overlapped segments covering the entire image.
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II. CAD TECHNOLOGY WITH FUSION TECHNIQUE:

In the year 2009, Meindert Niemeijer, Michael D.Abramoff bram Van Ginneken has proposed computer aided detection algorithm that detects all the lesions in the fundus image. This method is mainly used to detect single lesions in which it classifies each and every pixel in an image. The probability of abnormal pixels is estimated at each level based on the previous results. CAD algorithm is considered as a reliable option to detect the hemorrhage of a retinal image. In this method, it estimates the AUC (Area Under the Curve) and sensitivity level of red lesion pixel, bright lesion pixel; multi threshold level based fusion and Pathology detection procedure based fusion. They have proposed a compound computer aided diagnosis system that identifies the abnormalities at multiscale/ levels and the methods are determined as image quality verification, vessel segmentation, optic disk detection, bright lesion, red lesion. The main work carried out here is the fusion technique which is fusion based on single feature, likelihood distribution, normalization based fusion, multithreshold fusion and supervised fusion.

III. MULTISCALE AM-FM METHOD:

This Multiscale Amplitude Modulation-frequency-modulation technique is proposed by Carla Agurto, Victor Murray, Eduardo Barriga, Sergio Murillo, Marios Pattichis, Herbert Davis, Stephen Russell, Michael Abràmoff and Peter Soliz in the year 2010, by distinguishing the normal and the pathological retinal images to detect diabetic retinopathy. This method uses 120 regions which consist of four types of lesions and two types of normal retinal images. These regions include Microaneurysms, exudates, hemorrhages and normal vessel patterns. Here it involves the segmentation technique to overcome the abnormalities in the retinal regions. The first step in the analysis of retinal images has commonly been to process the images to remove lighting artifacts, which enhances detection of lesions. The main contribution of this research is the rigorous characterization of normal and pathological retinal structures based on their instantaneous amplitude (IA) and instantaneous frequency (IF) characteristics for the detection of DR in retinal images.

IV. TWO STAGE METHODOLOGY:

This methodology is mainly used to find the diabetic macular edema. The Diabetic Macular Edema is the second stage of diabetic retinopathy, which leads to vision loss. A two stage methodology is carried out to determine the detection and classification of diabetic macular edema. The technique majorly used here is globally characterized by feature extraction in a retinal image. This global characterization consists of two levels; they are novel representation and a rotational asymmetry measure in retina to overcome the risk of DME. The first level determines the supervised technique which is used to detect the normal or abnormal cases belongs to hard exudates. The second level estimates the severity of the abnormality, in which it is enhanced by means of rotational asymmetry. This level is based on the occurrence of hard exudates, in which it enhances the DR screening infrastructure for the assessment of retinal images. In this method the region of interest is first extracted and an intermediate representation of motion pattern of ROI (Region of Interest) is created. Relevant features are then classified into normal and abnormal

pixels. This approach has an advanced technique than the CAD system by removing the need for abnormal images. In this process there is no need for pre-processing of an image for the results. This method was suggested by K.Sai Deepak and Jayanthi Sivaswamy in the "Automatic Assessment of Macular Edema from Color Retinal Images "in the year 2012.

V. Ensemble Based System:

An ensemble based framework to detect diabetic retinopathy in retinal color image. Here they proposed a combination of internal component of Microaneurysms detector namely pre-processing method and extracting method. This pre-processing procedure includes Walter-Klein contrast enhancement, contrast limited adaptive histogram approach, vessel removal algorithm and extrapolation procedure and illumination equalization method. In this proposed approach the main process involved is MA (microaneurysms) detection to detect the region of convergence to recognize diabetic retinopathy. Their procedural framework rotates around this pre-processing method and the extracting based procedure gives the combinational result. This method was suggested by K.Sai Deepak and Jayanthi Sivaswamy in the "Automatic Assessment of Macular Edema from Color Retinal Images "in the year 2012.

VI. Optical disk segmentation:

In this method the optical disk segmentation carries the work of detecting the saturated red channel and determines the removal of blood vessels and bright region. It is the fastest and robust procedure used to identify the DR. This methodology adaptively changes the template size based on the OD (Optical Disk) radius estimation. Using the field of view and the image resolution, the employed methodology not only exploits the appearance of the optical disk featuring but also involves the main vessel orientation inside the optical disk in order to increase the robustness. ODS (Optical Disk Segmentation) method uses ASF(Alternative Sequential Filtering) and morphological deconstruction to remove the vessels and bright region distracters while retaining the shape of the papillary region. This OD localization and segmentation methodology does the work of normalization, then template matching process takes place with the directional matched filter. In this directional filter matching, the saturation detection in the red channel takes place by the blood vessel removal and bright region removal with least square ellipse fitting. Adapted methodology consists of three main processing steps namely OD size estimation, OD localization algorithm and OD segmentation algorithm. In the OD localization algorithm the background normalization, template matching, directional matched filter are the process involved. In the OD segmentation algorithm the image processing technique uses the saturation detection in the red channel by removing the blood vessels. This method was first applied by H.Yu, E.S.Barriga, C.Agurto, S.Echegaray, M.S.Pattichis, W.Bauman and P.Soliz in the "Fast Localization and Segmentation of Optic Disk in Retinal Images Using Directional Matched Filtering and Level Sets" in the year 2012.

VII. Visual Dictionary:

This algorithm detects the presence of diabetic retinopathy related lesion fusion from the retinal image; this follows an analytical approach which detects the red lesion and bright lesion without any pre or post processing. It works by creating a visual word dictionary by the point of interest in the region. Visual word dictionary is very helpful in featuring the red and bright lesion. Here these are the steps involved, first the database of the training sample is sequenced based on the region of interest .Then the POI (Point of Interest) is classified based on the visual word dictionary and then it is quantized based on the POI description. This is then converted into signature vector and fed as input to the SVM classifier, and then the detection process is headed to find the diabetic retinopathy.

Algorithm is formulated by Anderson Rocha, Tiago Carvalho, Herbert F.Jelinek, Siome Goldenstein and Jacques Wainer in the paper "Points of Interest and Visual Dictionaries for Automatic Retinal Lesion Detection" in the year 2012.Here the experiments were performed with fine fold cross validation and the ROC curves for red and bright lesions, here represents the best and worst choices for the dictionary sizes .This algorithm is implemented mainly to identify the type of lesion easily. This approach automatically calculates POI that is representative and highly distinctive in the lesion regions. This method is building a powerful visual dictionary upon POI. This approach is the characterization of lesions using visual works that incorporate information as texture.

VIII. Splat Feature Classification:

This is a recent paper by Li Tang, Meindert Niemeijer, Joseph M. Reinhardt, Senior Member, IEEE, Mona K. Garvin, Member, IEEE, and Michael D. Abràmoff, Senior Member in the year 2013 for detection of hemorrhage based on the splat feature classification approach. Splat is the group of pixels with same spatial location and colour. In this statistical approach the retinal image is partitioned into different segments of the entire image. The retinal area is segmented into bigger splats and the hemorrhage part if detected it is partitioned into smaller splats. A group of information is extracted from each splat to estimate its characteristics relative to its surroundings by the responses from a variety of filters, interactions with neighboring splats, and shape and texture information. An optimal subset of splat features is selected by a filter approach followed by a wrapper approach. The main process in splat feature approach is Scale-Specific image Over-Segmentation using Watershed algorithm; Splat-Based Reference Standard Acquisition which estimates the acquired hemorrhage and the Edge Effect Removal process which here is to remove the effect caused by applying the segmentation. Pixel-Based Feature Responses, Aggregation of Pixel-Based Responses, Splat-Wise Features and List of Splat Features are the process that evolves in the extraction of hemorrhage.

IX. Conclusion:

We have sketched many algorithms with their workings for detecting the presence of Hemorrhage in the color fundus image. In this surveyed paper the splat based classification method has an excellent approach to detect the

presence of the Hemorrhage .This is the latest method employed to screen the diabetic retinopathy in the color fundus image. There are many algorithms which are giving excellent result for detecting the presence of Hemorrhage, but still there is false detection of above 40% around the world. We have surveyed seven literature papers and listed their workings in accordance with their approach.

REFERENCES:

[1] Li Tang, Meindert Niemeijer, Joseph M. Reinhardt, *Senior Member*, *IEEE*, Mona K. Garvin, *Member*, *IEEE*, and MichaelD. Abràmoff*, *Senior Member*, *IEEE*Splat Feature Classification With Application to Retinal Hemorrhage Detection in Fundus Images.

[2] M. D. Abràmoff, J. M. Reinhardt, S. R. Russell, J. C. Folk, V. B. Mahajan, M. Niemeijer, and G. Quellec, "Automated early detection of diabetic retinopathy," *Ophthalmology*, no. 6, pp. 1147–1154, Apr. .

[3] O. Faust, R. AcharyaU., E. Y. K. Ng,K.-H. Ng, and J. S. Suri, "Algorithms for the automated detection of diabetic retinopathy using digital fundus images: A review," *J. Med. Syst.*, Apr. .

[4] M. Niemeijer, M. D. Abramoff, and B. van Ginneken, "Information fusion for diabetic retinopathy CAD in digital color fundus photographs," *IEEE Trans. Med. Imag.*, no. 5, pp. 775–785, May .

[5] Y. Hatanaka, T. Nakagawa, Y. Hayashi, M. Kakogawa, A. Sawada, K. Kawase, T. Hara, and H. Fujita, "Improvement of automatic haemorrhages detection methods using brightness correction on fundus images," in *Proc. SPIE*, 2008, vol. 6915, pp. 69 153E-1–69 153E-10.

[6] P. Jitpakdee, P. Aimmanee, and B. Uyyanonvara, "A survey on hemorrhage detection in diabetic retinopathy retinal images," in Proc. 9thInt. Conf. Elect. Eng./Electron., Comput., Telecommun. Inf. Technol. (ECTI-CON), Bangkok, Thailand, 2012, pp. 1–4, vol..

[7] N. V. Chawla, N. Japkowicz, and A. Kotcz, "Editorial: Special issue on learning from imbalanced data sets," SIGKDD Explorations, no. 1, pp. 1–6, 2004.

[8] K. Sai Deepak* and Jayanthi Sivaswamy, Member, "Automatic Assessment of Macular Edema From Color Retinal Images ," *IEEE*