Techniques for Detection of Diabetic Retinopathy: A Review

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Abstract: - Diabetic Retinopathy (DR) is an eye disease that often occurs in the retina as a result of diabetes mellitus in diabetic patients. Letting it untreated for a long time or not exercising proper caution can often lead to blindness. Diabetic patients must undergo regular eye checking for the identification of Diabetic Retinopathy. The National Diabetes & Diabetic Retinopathy survey report (2015-2019) shows that the existence of diabetes in India has increased by about 11.8%. The occurrence of Diabetic Retinopathy for the persons having age of 50 years or more is about 16.9%. A simpler, effective & user-friendly method is put forward which can be an important addition to the costlier methods that can help out in periodic eye examination which helps doctors to save time and increase efficiency.

Key Words: — ***Diabetic Retinopathy, retina, Survey report.***

I. INTRODUCTION

The human eye is an equally important organ in the human body as other organs. But the care and treatment given to the eye are far short. There are numerous diseases related to the human eye and Diabetic Retinopathy is one such disease that often occurs as a result of type 1 or type 2 diabetes in diabetic patients which affects the retina of the victim. Diabetic Retinopathy is classified mainly into two, which are Non-Proliferative Diabetic Retinopathy and Proliferative Diabetic Retinopathy. Non-Proliferative Diabetic Retinopathy refers to the case when there is no neovascularization in the eye. Non-Proliferative Diabetic Retinopathy is often characterized by Microaneurysms, Hemorhhages, and Exudates in the retina. The progression of Diabetic Retinopathy leads to Proliferative Diabetic Retinopathy in which there is the existence of neovascularization in the eye. Proliferative Diabetic Retinopathy is often marked by Vitreous Hemorrhage, Retinal Detachment in addition to neovascularization. Fluorescein Angiography, Optical Coherence Tomography, Vitrectomy are the treatment methods available at present for Diabetic Retinopathy.

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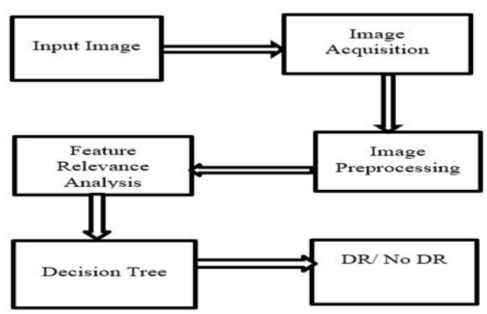
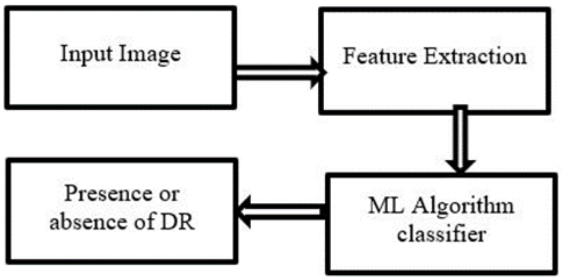
But these methods are costly and hence limit the poor people from regular eye check examination. Here a multitude of methods is presented over here for the identification and classification of Diabetic Retinopathy.

II. LITERATURE REVIEW

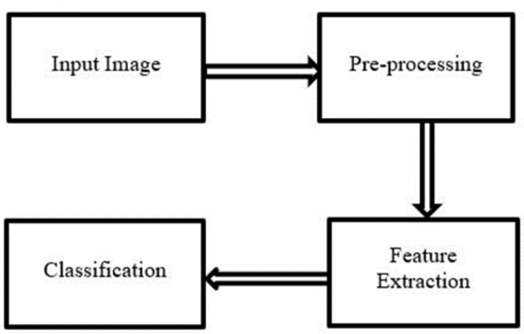
Argade (2015) presented a work using image processing and data mining [1] for the detection of DR. Firstly image the acquisition is done after which the image is pre-processed through the grey level difference method and filtering. Then feature reference analysis is performed, which uses optic disc and cup, exudate, vessel detection. Sobel edge extraction and eclipse filtering are used for optic disc and cup detection. KNN is used for exudate detection. Histogram thresholding and smoothing for vessel detection. The features extracted are trained on a decision tree and classify whether the eye is having DR or not.



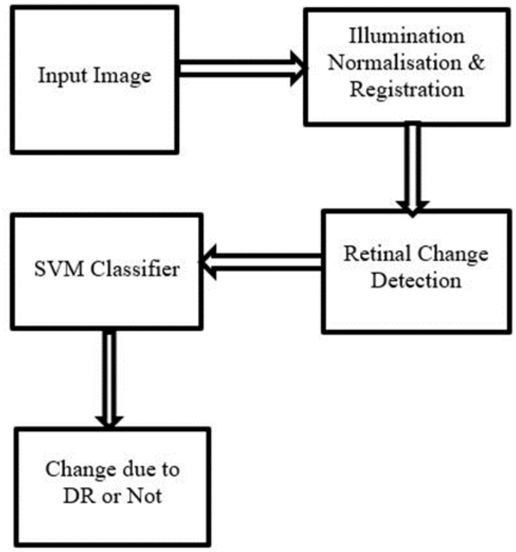
Bhatia (2016) proposed a method of using Machine Learning [2] to detect the presence or absence of Diabetic Retinopathy using the features of the extracted retinal images. The methodology first consists of feature extraction which in turn consists of the assessment of image-level components, lesion specification, and anatomical components. Then secondly, the machine learning algorithm is used to train the classifier and determines the presence or absence of DR-related changes.



Lambade (2016) proposed soft computing techniques [3] for the detection of DR. This technique consists of a pre-processing step, which uses the grayscale conversion of color fundus images and then the histogram equalization of these color fundus images. After preprocessing step, the Gray level co-occurrence matrices (GLCM) and statistical moments are used to extract texture features from images. Then these images are classified into four classes using the classifiers namely SVM, Random Forest, Gaussian Naïve Bayes, AdaBoost, and Gradient Boost. The SVM classifier showed a maximum accuracy of 88%.

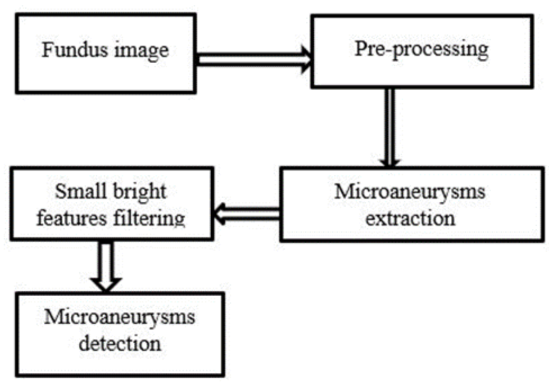


Adal (2017) implemented a system for automated diagnosis of DR using the retinal changes in fundus images [4]. At first, the image is image normalized and registered which enhances the details of the retina. Then the retinal changes are detected through the use of a Log Operator. The detected changes are then used to train the SVM classifier which then classifies the change due to DR or not. The implemented system achieved about 80% of sensitivity.

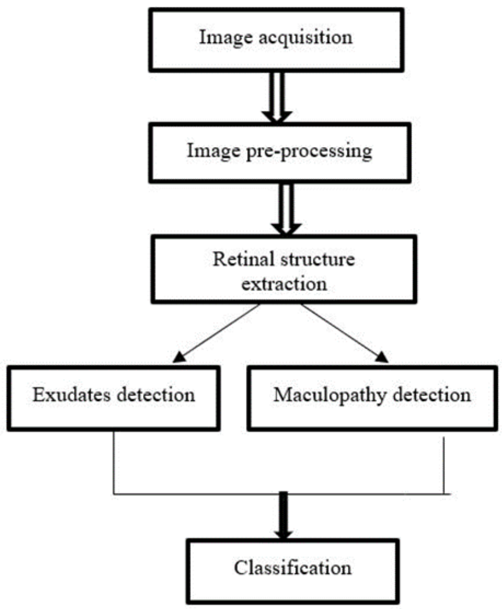


Sreng (2017) has introduced to detect microaneurysms (MIs)

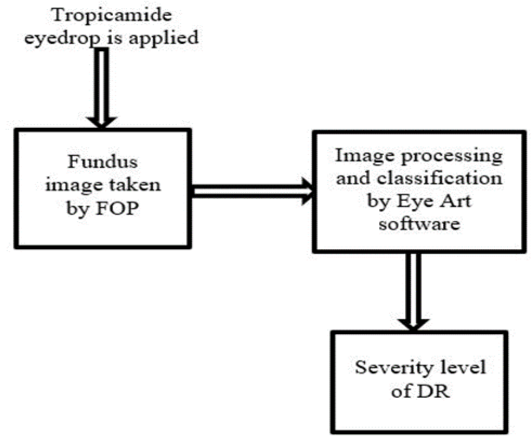
By image segmentation techniques [5]. There are four processing stages. The first step is preprocessing which is implemented to reduce noise and improve image contrast, which will help reduce processing time. The next step is to segment the image using canny edge detection and maximum entropy thresholds. Canny edge detection is used to define the lesion as well as to detect discontinuities in brightness in the image. Then the entropy thresholding method is used to define the bright lesion subtracted from the result. The MIs spanning regions are then chosen based on the eccentric and field method. Finally, using morphological algorithms to rule out MIs characterization.



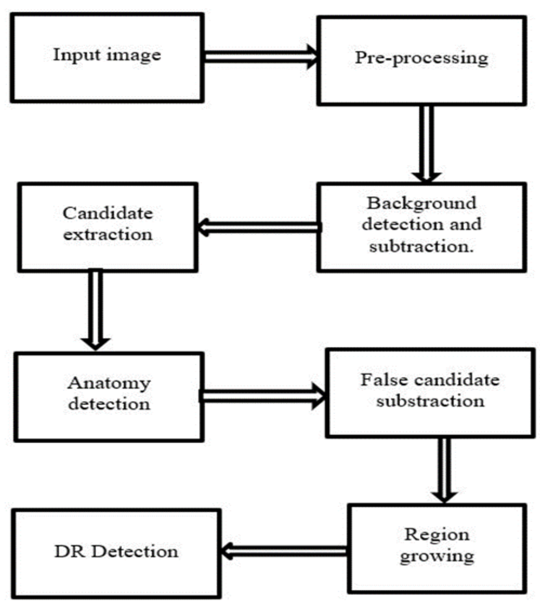
Amrita (2018) has introduced a method to detect both Microaneurysms (MIs) and Hemorrhages (HEs) by image processing techniques [6]. The first step is image acquisition from the Fundus Image dataset. The image is then preprocessing for accurate exudate identification. The next step is retinal structure extraction performed using an optical disk localization technique. Exudates and maculopathy occur after extraction. It is then classified into five stages (no DR, mild DR, moderate DR, Severe DR, proliferative DR), which are classified by the Support Vector Machine (SVM). If HEs are detected, the processed image is displayed on the axes, and if MIs are detected along the vessels, small dots containing the processed image are detected.



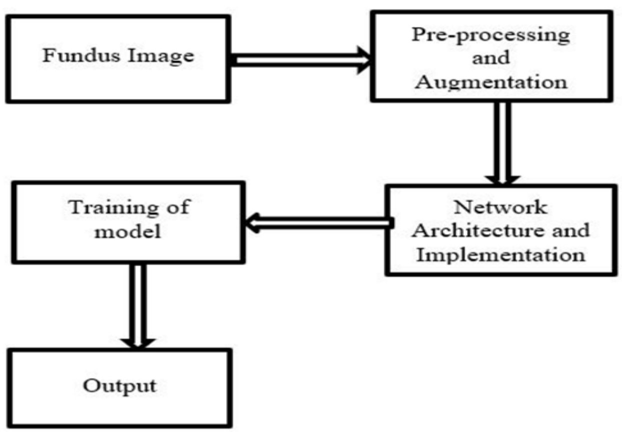
Ramachandran Rajalakshmi, Radhakrishnan Subashini, Ranjit Mohan Anjana, Viswanathan Mohan (2018) proposed a method for Automated diabetic retinopathy detection in smartphone-based fundus photography using artificial intelligence [7]. EyeArt software is used for detecting the presence of DR. In this methodology firstly tropicamide eye drop is applied for dilating the eye after the preliminary examination. After that, the retinal images were acquired using Remidio fundus on a phone (a smartphone-based imaging device). Four different fields of 45° field FOPs are captured. The obtained fundus image can be graded by an ophthalmologist or by using EyeArt software. Eye-based software that can the presence, size, position, and several retinal lesions. It will help to detect the presence or absence of surrogate markers for CSME along with DR detection.



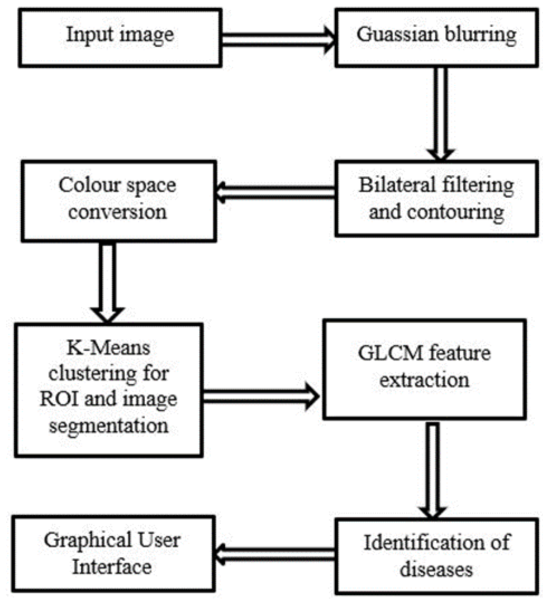
Kranthi Kumar Palavalasa and Bhavani Sambaturu (2018) proposed a method for automatic diabetic retinopathy detection using digital image processing [8]. Firstly the fundus image is captured using a fundus camera and that image is pre-processed to enhance the contrast of the image by using CLAHE. Secondly, by using the median filter operation the unwanted background of the image is removed. After that candidate extraction, anatomy detections, false candidate subtraction, and region growing are performed to extract the desired characters. Region growing algorithm is used for the detection. The region growing algorithm is based on a comparison of local pixel properties in the defined local region. By evaluating the algorithm we can determine whether the patient is DR affected or not.



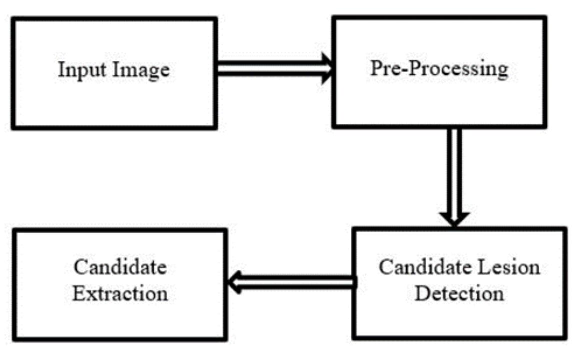
X. Zeng (2019) proposed a method for automated DR detection based on binocular Siamese like Convolutional Neural Network [9]. In this method the images of both eyes are given as input at a time and they are classified as five classes according to the level of disease. Firstly, the fundus images are pre-processed and augmented. Then the two fundus images are transmitted to the Siamese-like block. Then using inception V3 and weight sharing property, the features of both the eyes are extracted at the same time, and scores of the left and right eye are obtained. This model is then trained using good optimizers like Adam. This model obtained a sensitivity of 82.2% and an AUC of 0.951.



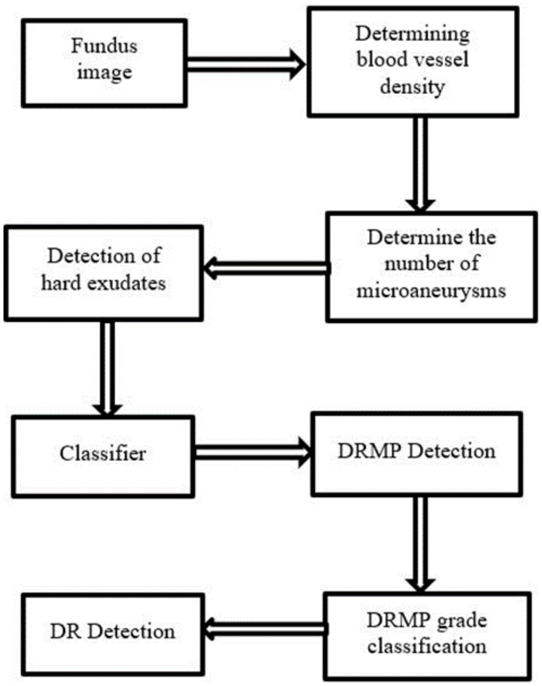
Subhashini (2019) introduced a way to detect diabetic retinopathy by graphical user interface (GUI) image processing techniques [10]. It is initially being applied by applying Gaussian blurring of the fundus image so that the image can be processed. Then bilateral filtering and contouring were done. This is followed by a color space conversation and creating a scale fundus image. And then apply K-mean clustering to identify the region of interest and also the segmentation performed. Next is to test retinal disease. Implicit pictures working with strategies are used on pictures of the retina along these lines. The most fundamental changes that develop in funds from the perspective of the disease are exudates, hemorrhages, and microaneurysms. The required or practical structure to deal with pre-processing involves changing photos. Photos are resized and inspected at the required size, which is also called 512 X 512 at the required point. After which the edge recognizable proof process is used to chart the image properly. The final step is to upload the fundus image by clicking the button provided by the graphical user interface (GUI).



L. Qiao, Y. Zhu, and H. Zhou (2020) proposed a method for DR detection using a prognosis of microaneurysm and early diagnosis system for non-proliferative diabetic retinopathy based on deep learning algorithms [11]. The primary procedure in this method is the pre-processing that include enhancement for dark lesions on the edge of curvelet and optimizing bright lesions using an optical bandpass filter. Following that the candidate lesion is detected using Gaussian filtering matched filters and Laplacians and maximizing mutual information. The final step is the candidate extraction using principal component analysis and Sparse PCA.



Andres Gonz, Alex Enrique, V. CarreraRicardo Carrera proposed a method for automatic detection of diabetic retinopathy using SVM [12]. Here Messidor database with 1200 eye fundus images is used. The input fundus image is processed to extract the desired features. Extraction of features involves determining the blood vessel density, number of microaneurysms, and detection of hard exudates. After that based on the 8 quantitative features used in the classifier, the image is classified. Matlab is the software used here. The evaluation process consists of DRMP detection and DRMP grade classification. Here the SVM classifier is trained by using the features of 152 grade 0 and 149 grade 3 images. The best performance was acquired using a multiclass SVM with a linear kernel function. This method has an accuracy of about 92.4%.



III. Conclusion

Several novel techniques have been presented for the timely and accurate detection of Diabetic Retinopathy using different techniques. All the techniques presented here use the retinal features extraction process for distinguishing the features of retina having Diabetic Retinopathy from the normal ones using different methods of processing and computing. Then it is trained based on different algorithms and classifies and identifies Diabetic Retinopathy.

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