Analysis Of Various Diabetic Retinopathy Detection Techniques

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Abstract : The image vision is the approach which can process the pixels which are stored in the form of the pixels. The diabetic retinopathy is the approach of diabetes detection using image processing and machine learning. The diabetic retinopathy detection have the various steps which the pre-processing, feature segmentation, segmentation and classification. The technique of textual feature extraction is applied for the feature extraction, circular disk segmentation is applied for the segmentation and various type of classification algorithms like SVM, KNN, decision are applied for the classification of diabetic retinopathy portion from the whole image. It is analyzed that the SVM is best classifier which can classify diabetic and non diabetic portion from the image.

Keywords: Diabetic Retinopathy, Circular disk segmentation, Color features, Classification

1. INTRODUCTION
Diabetic retinopathy or DR is a very severe retinal disease. This is the major cause of sightlessness in the working population of the developed nations. According to a survey, more than 93 million people all over the world are suffering from this disease. This disease makes its prey to the diabetic people. The retina as a membrane covers the backside of the eye. This part is extremely sensitive to light. The retina does the conversion of light into signals. The human brain can interpret these signals. DR disease ruins the blood vessels in the retinal tissue. These vessels start leaking fluid and result in visions loss. There are mainly two categories of diabetic retinopathy disease. These categories are known as PDR (Proliferative diabetic retinopathy) and NPDR (Non-proliferative diabetic retinopathy) [1]. The first category refers to the most advanced DR stage. In PDR, novel, anomalous blood vessels generate in the retinal tissue. On the other hand, NDPR is the milder stage and generally does not show any symptoms. The use of machine learning algorithms is very common for diabetic retinopathy detection. A lot of algorithms have been presented by different researchers over the time. The general process of DR detection using machine learning involves image pre-processing, feature extraction and classification. The first step known as image pre-processing makes use of various image enhancement and restoration methods for the normalization of retinal fundus images. In this step, the image quality gets improved. The use of different filtering techniques in this step reduces the blocking artifacts in the retinal fundus image. In this step, the conversion of RGB retinal image is carried out into many channel images. These images include gray scale, R, G and B component images. The main aim here is to separate objects from the background [2].

The use of CLAHE (Contrast-limited Adaptive Histogram Equalization) approach enhances the contrast of local regions in gray scale images. The next step in DR detection is feature extraction. This step involves three tasks i.e. optic disc elimination, blood vessels extraction & removal and detection of exudates and micro-aneurysms. The OD (optic disc) is a round region in the backside of the eye. In this region, retinal nerve fibers collectively make the optic nerve. Exudates contain high and similar brightness levels of OD. Hence, the removal of OD from the image of retina is essential. Region properties and region detection approaches are generally used masking and removing the high intensity OD. The use of canny edge detection is quite popular for detecting the counter. This approach preserves all local maxima and thereby improves the blurred images. The second task in feature extraction is the extraction and removal of blood vessels. In order to detect microaneurysms and exudates, it is necessary to remove blood vessels and OD from the retina image [3]. Blood vessels have same concentration level as micro-aneurysms while the concentration level of OD is similar to exudates. The blood vessels with high contrast level can be removed by applying Dilation operation on the intensity image. Then, the structuring element is used to fill the small image holes via dilation operation. Structuring elements come in different shapes such as diamond, disc, round and so on. However, the use of flat disc shaped structure is quiet common for the removal of OD (optic disc) and blood vessels. The last task in feature extraction is the detection of exudates and micro-aneurysms. The exudates features are detected after the removal of blood vessels and optic disc from the retinal image. Exudates represent a bright lesion of retinal image. Morphological closing operation is generally used for the detection of this feature. The implementation of this closing operation is carried out on the eroded fundus image. Micro-aneurysms are other important features of diabetic retinopathy. In order to detect micro-aneurysms features, opening morphological operation are applied [4]. In this operation, dilation follows erosion while the micro-aneurysms appear as red spot depicting swelling in retina. The extraction of features is carried out after the detection of exudates and micro-aneurysms in the color fundus images. All extracted are features are delivered to different classification algorithms after computing. Machine learning algorithms are generally divided into two categories i.e supervised and unsupervised. SVM (Support vector machine) is a very
popular and adaptive supervised machine learning algorithm. This algorithm can be used to do both classification as well as regression. However, it is generally used to resolve classification issues. This algorithm represents different classes in a hyper plane in multidimensional space [5]. This algorithm iteratively generates hyper plane for minimizing errors. Partitioning of datasets into various classes for finding a maximal marginal hyperplane is the main objective of this algorithm. Actually, the implementation of this algorithm is carried out with kernel. The kernel does the conversion of an input data space into the required format. KNN (K-nearest neighbors) is also a very popular supervised machine learning algorithm. Like SVM, this algorithm can be used for both classification and regression predictive issues. This algorithm makes use of ‘feature similarity’ concept for generating predictions about the novel values of data objects. It implies that a value will be given to the novel data object on the basis of its closeness to the objects in the training set. It is a simple algorithm. This algorithm stores all existing cases and does the classification of new cases on the basis of a similarity measure. One more commonly used algorithm for DR detection is Decision tree or DT. It is the most robust and famous tool for classification and prediction. The configuration of this algorithm resembles a tree. In DT, every internal node represents a test on a feature. Every branch denotes a test result while every leaf or terminal node takes hold of a class label.

2. LITERATURE REVIEW

Enrique V. Carrera, et.al (2017) presented a computer based diagnosis for detecting diabetic retinopathy disease in automatic manner [7]. This work applied digital image processing on the images of retina for this purpose. The main purpose here was to perform the classification of NPDR (Non-proliferative Diabetic Retinopathy) at any image of retina. The achieved outcomes showed the efficiency of recommended approach in DR detection. This approach achieved sensitivity and predictive capacity of 95% and 94% respectively. This work also evaluated the robustness of recommended approach with the variation in different metrics. The future work would be focused on clinically evaluating and integrating the existing algorithms as an instrument for DR detection. Karan Bhatia, et.al (2016) implemented ensemble machine learning algorithms on the features retrieved from segmented retinal images for detecting diabetic retinopathy disease [8]. This work made use of different classification algorithms to make decision of forecasting the occurrence of DR (Diabetic Retinopathy) disease. The classification algorithms used in this work showed good performance. The future work would be focused on developing new techniques of DR detection for helping doctors in the early diagnosis of this server disease. Valliappan Raman, et.al (2016) used CAD (Computer Aided Detection) system for the classification of retinal images for detecting diabetic retinopathy disease [9]. This system used machine learning algorithms for developing patterns of DR. The recommended system had the ability to detect the different stages of DR disease precisely. The comparison of classification outcomes generated by the recommended system was carried out with the outcomes generated by other existing approaches. This system showed good accuracy in feature extraction, classification and the grading of NPDR (Non-proliferative Diabetic Retinopathy) lesions. The future work would be focused on improving the recommended system in terms of more parameters such as sensitivity, specificity, precision etc. Omer Deperlioglu, et.al (2018) implemented image processing and deep learning algorithms on the fundus images of retina for detecting DR (Diabetic Retinopathy) disease [10]. This work made use of ConvNet (Convolutional Neural Network) for classifying the retinal fundus images. The tested outcomes showed that the recommended approach achieved accuracy, sensitivity, specificity, precision, recall and Fscore of 97%, 96.67%, 93.33%, 97.78%, 93.33% and 93.33% respectively. These outcomes proved the efficiency of recommended approach in the diagnosis of DR (Diabetic Retinopathy) disease using the fundus images of retina. The future work would be focused on developing new more efficient tools for DR diagnosis. Asti Herliana, et.al (2018) implemented PSO (Particle Swarm Optimization) algorithm for the selection of optimal Diabetic Retinopathy features on the basis of DR Dataset [11]. This work made use of NN (Neural Network) classifier for the classification of selected features. The outcomes revealed that NN based PSO algorithm showed satisfactory result of 76.11%. The future work would be focused on improving the accuracy of DR detection using other image processing algorithms with retinal images in the form of an object. Shuang Yu, et.al (2017) used deep ConvNet (convolutional neural network) to detect pixel-wise exudates for DR disease [12]. Initially, the training of CNN model was carried out using expert labeled exudates image patterns. The recommended ConvNet model on the test database achieved pixel-wise accuracy, sensitivity and specificity of 91.92%, 88.85% and 96% respectively. The future work would be focused on the use of more openly existing databases to test the recommended technique. More exudate images could be included in the training set in the nearby future. Yuchen Wu, et.al (2019) presented a transfer learning based approach for the detection of DR (diabetic retinopathy) disease [13]. At first, the downloading of data was carried out from official website of Kaggle. Afterward, improvement in data was carried out using different methods. This work made use of some already trained models. This work made use of ImageNet dataset for the pre-training of each NN (Neural Network). At last, the division of images was carried out into five different types of DR diseases on the basis of their severity. The tested outcomes showed that the recommended approach achieved classification accuracy of 60%. The recommended approach was more robust and simple than the earlier approaches. The future work would be focused on developing new techniques of DR detection for helping doctors in the early diagnosis of this server disease. Toan Bui, et.al (2017) presented an automated segmentation algorithm for detecting cotton wool spots in the retinal images for detecting DR (Diabetic Retinopathy) malady [14]. This work made use of an openly available data set DIARETDB1 for evaluating the recommended approach. The achieved outcomes demonstrated that the recommended technique had the ability to segment cotton wool in efficient manner. This approach achieved good sensitivity, specificity and accuracy of 85.9%, 84.4% and 85.54% respectively. The future work would be focused on improving accuracy of DR detection using various machine learning algorithms and more complicated attributes.
3. CONCLUSION

In this paper, it is concluded that diabetic retinopathy is the topic of computer vision and machine learning. The computer vision is the approach which can process the information which is stored in the form of pixels. The machine learning is the method which can classify the data into certain classes based on the training set. The diabetic retinopathy detection have various steps which are preprocessing, feature extraction, segmentation and classification. The technique of SVM is the best classification algorithm which can classify diabetic and non-diabetic spots from the input image.
4. REFERENCES


