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Deep Multiple Instance Learning for Automatic Detection of Diabetic Retinopathy in Retinal Images

Priyanka Thangamani¹, Elango Sathappan²

Department of Applied Electronics, Arunai Engineering College- Thiruvannamalai, India¹

The Head of Department, Department of ECE, Arunai Engineering College- Thiruvannamalai, India²

ABSTRACT: This project proposes a method for Diabetic Retinopathy detection, which jointly learns features and classifiers from data and achieves a significant improvement on detecting DR images and their inside lesions. Specifically, a pre-trained Random Forest is adapted to achieve the DR estimation, and then global aggregation is used to make the classification of DR images. Further, the authors propose an end-to-end multi-scale scheme to better deal with the irregular DR lesions. For detection of DR images, they achieve an area under the ROC curve. GLCM is used for Feature Extraction for the purpose of DR image features. The image of DR affected and not affected will be classifier with higher accuracy.

I.INTRODUCTION

Diabetes now has become one of the main challenges to our human health. According to the estimation of International Diabetes Federation, the number of diabetic patients will rise up to 592 million by 2035 [1]. As a common complication of diabetes, diabetic retinopathy (DR) can cause severe vision loss and even blindness in this population. It is not only a personal catastrophe to the individual but also a threat to the nation's economy. Fortunately, timely treatment of DR can help reduce the risk of such vision loss. In order to diagnosis DR early enough for an optimal treatment, it is necessary to deploy regular DR screening in the large diabetic population. Thanks to the development of color fundus photography, common DR lesions can be observed efficiently and non-invasively. C.Nagarajan *et al.*[6] proposed the clinical burden of examining massive retinal images, developing reliable methods for automatic detection of DR becomes an important issue in a screening program. Over the last two decades, numerous methods have been proposed for automatic DR detection. A comprehensive review can be found in [2]. A typical strategy adopted by most methods is to detect specific DR lesions before making a diagnose for the whole retinal image. Supervised learning techniques are usually applied to classify the segmented candidates or image patches into normal and abnormal classes. Such methods rely on the manual annotation of the DR lesions, which costs clinicians much heavier workload compared to the DR grading of retinal images. In consequence, it hinders the formation of larger training datasets, from which these data-driven methods could learn better to tackle different DR situations. C.Nagarajan *et al.*[10] proposed the annotation cost and make more retinal images available for learning, a weakly supervised learning technique named multiple instance learning (MIL) [3] has then been studied by different research groups [4–7]. Given only image level labels, MIL can achieve both detection of DR images and DR lesions. Specifically, it treats retinal images as bags and their inside patches as instances. Then following the standard assumption that a DR image contains at least one DR patch and that a normal image only contains normal patches, various models have been explored to find out those discriminative DR patches [4–7].

Both classifiers for DR patches and DR images can be learned using only image-level labels. However, so far these models still use handcrafted features to characterize image patches. They fail to benefit from the larger datasets brought by MIL, often resulting in inferior detection performance compared to previous supervised learning methods.

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II. RELATED WORKS

In this section, we are going to review related work in two aspects. First, we will give an overview of existing MIL methods for DR detection. Second, we will review several studies on deep MIL, especially for the medical image processing. T Chandrakumaret al.(13) They proposed deep learning approach such as Deep Convolutional Neural Network(DCNN) gives high accuracy in classification of these diseases through spatial analysis. A DCNN is more complex architecture inferred more from human visual perspectives. The architecture deployed with dropout layer techniques yields around 94-96 percent accuracy. Also, it tested with popular databases such as STARE, DRIVE, kaggle fundus images datasets are available publicly. C.Nagarajan *et al.*[15] [9] [21] proposed The method is able to automatically learn features from the raw images and predict the patterns. Extensive experiments have been conducted on two public retinal images databases (DRIVE and STARE), and comparisons with other major studies on the same database demonstrate the promising performance and effectiveness of the proposed method.

A.T.Elliott et al. (15) To determine if neural networks can detect diabetic features in fundus images and compare the network against an ophthalmologist screening a set of fundus images. 147 diabetic and 32 normal images were captured from a fundus camera, stored on computer, and analyzed using a back propagation neural network. The network was trained to recognize features in the retinal image. The effects of digital filtering techniques and different network variables were assessed. J.Lachure et al. (16) They detect retinal micro-aneurysms and exudates for automatic screening of DR using Support Vector Machine (SVM) and KNN classifier. The detection of red and bright lesions in digital fundus photographs is needed. Micro-aneurysms are the first clinical sign of DR and it appear small red dots on retinal fundus images. To detect retinal micro-aneurysms, retinal fundus images are taken from Messidor, DB-rect dataset.

P.Aruna et al.(17) They used to diagnose diabetic retinopathy, two models like Probabilistic Neural network (PNN) and Support vector machine (SVM) are described and their performances are compared. Experimental results show that PNN has an accuracy of 89.60% and SVM has an accuracy of 97.608 %. S.Girardi et al.(18) The paper is to develop and validate systems for detection of hard exudates and classify the input image as normal or diseased one. Performance analysis of SVM and KNN classifiers is presented. Images classified by these classifiers are validated by expert ophthalmologists.

M.L.Lee et al.(19) They demonstrate the functionality through pre-segmentation of input images with a fast and robust but loose segmentation step, The objects then undergo a spatial transformation into a reduced space, retaining but a compact high-level representation of the appearance. Additional attributes may be abstracted as raw features that are incorporated after the convolutional phase of the network. They compare the performance against existing approaches on the challenging problem of detecting lesions in retinal images.

III. EXISTING MODEL

- Most of the Application are used supervised learning method. The disadvantage of this method is the segmented image is compared to the original reference image. Hence large time is needed.
- Time consumption is more
- In the existing method, the Diabetic Retinopathy images will be identified using the Convolution Neural Networks (CNN). Even though the images will be classified, the accuracy and precision will be comparatively less.

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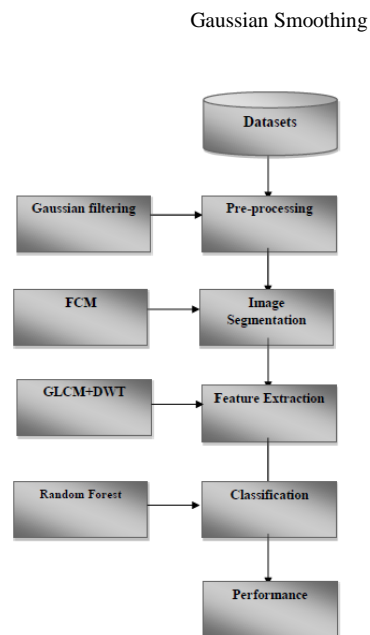
DISADVANTAGES:

- Accuracy is less
- Supervised technique is applied
- Precision value is also less

IV. PROPOSED FRAME WORK

- In our proposed system, by applying ensemble of machine learning classifying algorithms on features extracted from output of different retinal image processing algorithms, like diameter of optic disk, lesion specific (micro aneurysms, exudates), image level (pre-screening, AM/FM, quality assessment).
- Decision making for predicting the presence of diabetic retinopathy was performed using Random Forest. Here GLCM (Gray Level Co-Occurrence Matrix) is used for feature extraction. Fuzzy C-Means (FCM) is used for image segmentation.
- Here we will get the high Accuracy compared to all other existing methods of classification.
- Processing time is very less compared to Neural Network methods.

V. BLOCK DIAGRAM



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The Gaussian smoothing operator is a 2-D convolution operator that is used to 'blur' images and remove detail and noise. In this sense it is similar to the mean filter, but it uses a different kernel that represents the shape of a Gaussian ('bell-shaped') hump. This kernel has some special properties which are detailed below.

FCM:

Fuzzy c-means (FCM) is a method of clustering which allows one piece of data to belong to two or more clusters. This method (developed by Dunn in 1973 and improved by Bedeck in 1981) is frequently used in pattern recognition. Straightly speaking, this algorithm works by assigning membership to each data point corresponding to each cluster center on the basis of distance between the cluster and the data point. More the data is near to the cluster center more is its membership towards the particular cluster center. Clearly, summation of membership of each data point should be equal to one. The algorithm is based on minimization of the following objective function: where m (the Fuzziness Exponent) is any real number greater than 1, N is the number of data, C is the number of clusters, u_{ij} is the degree of membership of x_i in the cluster j , x_i is the i th of d -dimensional measured data, c_j is the d -dimension center of the cluster, and $\|*\|$ is any norm expressing the similarity between any measured data and the center.

VI. SIMULATION RESULTS

The result obtained from the diagnosis of DR has been shown in figure. Simulation has been performed in MATLAB R2015a. Accuracy of proposedDR detection system are evaluated based on sensitivity and specificity.

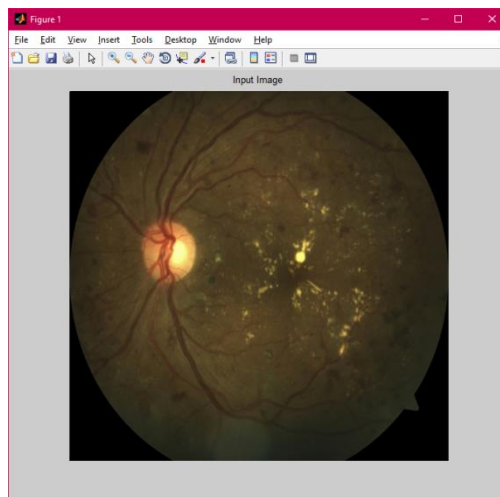


Figure 1:Input image

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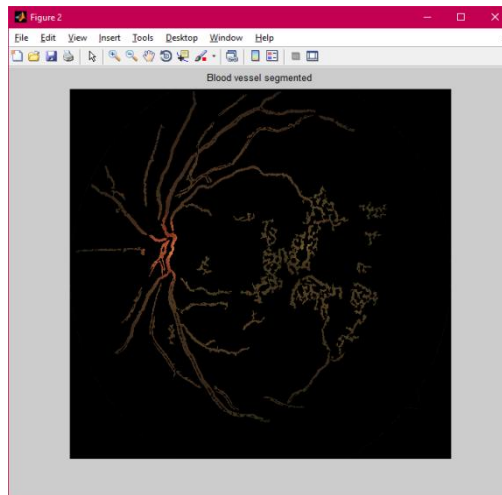


Figure 2: Blood vessel segmented

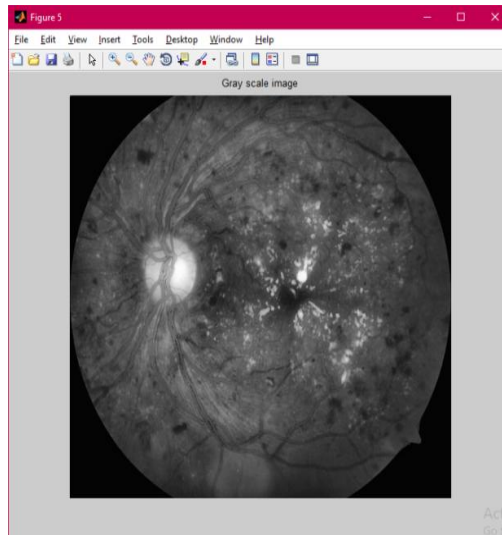


Figure 3: Gray scale image

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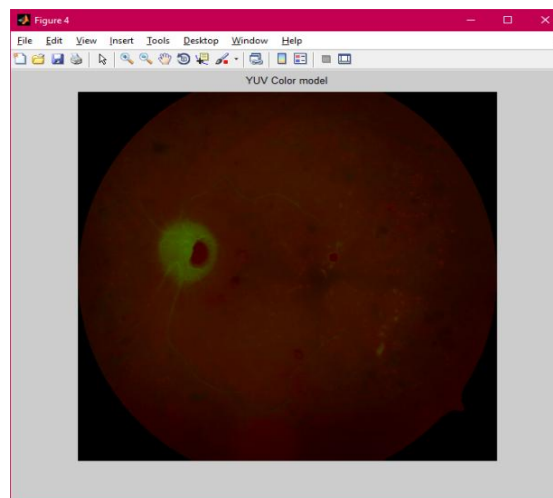


Figure 4: YUV Color model

VII.CONCLUSION

This project is proposed and evaluated a method for Exudate detection using FCM method. The color retinal images were segmented using fuzzy C-means clustering following some key preprocessing steps. To classify the segmented regions into exudates and non-exudates, an artificial neural network classifier was investigated. To classify the segmented regions into exudates and non-exudates, an artificial neural network classifier was investigated. This study indicates that automated evaluation of digital retinal images could be used to screen for exudative diabetic retinopathy. The significant contributions of this work are: 1) using median filter to reduce the irregular edges or smoothing the edges. 2) Applying FCM (fuzzy c-means) algorithm for finding the ratio of the disease. A major advantage of our algorithm is which implies greater accuracy of exudates detection. This work can be extended to develop similar diagnostic tools for other ocular diseases and combining it with telemedicine application, for remote, inaccessible and rural areas may prove to be of significant benefit to diagnose various retinal diseases.

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