Design of Density Clustering In Diabetic Retinopathy Based Eye Fundus Segmentation

Naluguru Udaya Kumar \(^1\), Thelapolu Nikitha \(^2\) and Srinivas Bachu \(^3\)

1, 3 Associate Professor, Marri Laxman Reddy Institute of Technology and Management (Autonomous), Department of ECE, Dundigal, Medchal, Hyderabad, Telangana, India
2 Research Scholar, Marri Laxman Reddy Institute of Technology and Management (Autonomous), Department of ECE, Dundigal, Medchal, Hyderabad, Telangana, India

joyudaya@gmail.com, thelapoluniki123@gmail.com

Abstract. In order to prevent further complications, we learned in this paper that earlier diagnosis is critical in Diabetic Retinopathy (DR). The disease can be classified into one of two stages (the early stage of non-proliferative and later stage of proliferative diabetic retinopathy) of Eye Fundus Images (EFI), diagnosed on the basis of the presence and quantities of a complex series of lesions such as microaneurysms, haemorrhages or exudates. Therefore it is important to properly segment regions of potential lesions to demonstrate and classify the lesions and the degree of DR. Density clustering approaches are promising candidates for the isolation of individual lesions, and can be used along with effective methods for vascular tree elimination, extraction and classification. In this article, our approach, findings, tradeoffs and assumptions for segmenting and detecting individual lesions are reported.

Keywords: Segmentation, Density Clustering, Diabetic Retinopathy, MATLAB, Eye Fundus.

Introduction

The use of digital image processing techniques has improved to scan DR after the 2005 Liverpool UK conference suggested it as a means of screening DR. More work has been undertaken to enhance some of the current screening process although new approaches have been developed to make this method more adaptive and more specific. Sensitivity refers to the abnormal fundus frame percentage that is classified as abnormal by the system, while specificity can be described as the normal fundus picture percentage classified as normal. Any of these considerations would boost the process. The bulk of the available study will normally be divided into BDR and PDR screenings, whilst the ophthalmologist remains on SDR diagnosis. The identification of the microaneurysm and exudates is limited, but most of the tasks have been carried out in the detection of vascular abnormalities using images of the colour fundus [1].

1. Literature Survey

Automated detection and gradation of vascular abnormalities in diabetic retinopathy has been used to detect and grade the images of the retina in the case of scale and orientation of the selective Gabriel. Due to its ability to differentiate between images due to its difference across proportions and direction, scale and angle analysis have been used. The initial filtering of the image is performed by Gabor philtre banks. The banks consist of several philtres suited to particular measurements and orientation and are run in the Fourier domain. The performance is evaluated afterwards. This approach indicates that BDR and PDR exist only, but it does not show the coordinates, the exact locations or the actual illness[2].Automatic diabetic retinopathy diagnosis by way of learning, use on colour fundus pictures of convolutional neural networks (CNN) for identification of the diabetic retinopathy. With a validity sensitivity of 95%, the network models obtained a comparable measurement efficiency with baseline...
literature data. Furthermore, they investigated multicatic classification models, and showed that errors exist mainly due to CNN's inability to identify subtle disease characteristics in the misclassification of mild diseases. They find that before processing with comparison, it increases the identification of subtle characteristics and guarantees the allegiance of a data set through expert checking of class marks. Move learning to pre-trained, ImageNet versions of GoogleNet and AlexNet increased peak test set accuracies to 74.5% by 68.8% by 57.2% on 2- and 3-and 4-and-a-ary models [3].

A short analysis of diagnosis by pre-processing and segmentation procedures of diabetic retinopathy in human eyes. This paper offers a short description of DR identification in human eyes using a combination of preprocessing and segmenting techniques. This identification is subject to the RNFL field. If the whole region of nerve fibres is smaller than diabetic retinopathy (DR) is impaired, therefore if the area of the nerve network is higher, the diabetic retinopathy does not affect the eyes and thus it is usual. Diabetics believe that any organ has an effect on the welfare of the human being. An organ like that of the eye of man. Due to the visual nerve associated with the brain, this DR triggers losses of sight to the human eye. The photos in retinal fundus are typically used in images of disease for diagnosis and examination. Raw retinal fundus photos by computer algo are hard to process [4].

Implementing Process and Feature Extraction of Fundus Images under Diabetic Retinopathy discussed that the diabetic retinopathy is the effect of DM (diabetic mellitus) to human vision that has resulted in the major cause of blindness. Timely diagnosis of diabetic retinopathy is very important in diabetes treatment. Blood vessel is primary retinal feature which indicates retina pathologies. The paper showed two designed GUI interfaces used for processing fundus images. The first GUI interface performed green channel, CLAHE, morphological operation, segmentation, and edge detection. The second GUI is concerned with line tracking of the input retina image along with plotting histogram [6].

Digital fundus analysis is the segmentation of photographs' anatomical shapes, according to a study of segmentation strategies for diabetic retinopathy identification. They consist of blood vessels, red tumours, exudates and the optic disc. We would be able to categorise these images as PDR or NPDR. It is noticed in optic disc segmentation that the maximum results are obtained by the fractional derivative technique. Prepossessation of FGLG and then morphological application of blood vessel segmentation. The method yields the optimal outcome. Where the morphological process usually provides better outcomes, as in red lesions [5].

Diabetic retinopathy detection using image processing: A survey has explained several techniques of image processing for early detection of DR based on features such as blood vessels, exudes, haemorrhages and microaneurysms including improvement of images, segmentation of image, image fusion, morphology, classification and registration. This article discusses previous studies on the use of DR-feature recognition image processing techniques. The techniques of image processing are assessed depending on its performance [6].

Diabetic retinal fundus Pictures: Preprocessing and features for early diabetes retinopathy diagnosis, raw retinal fundus images are preprocessed by removing the green pathway, equalising histograms, optimising the picture and redimensioning techniques. Also, 14 functions are derived for quantitative analysis from pre-processed images. The measurements are administered using the Kaggle Diabetic Retinopathy dataset and the resulting values and standard deviations of the functions are measured in mind. The result was the best-ranking exudate zone with a mean gap of 1029.7. The result was provided because the images of diabetic retinopathies in the three groups are fully absent from typical diabetic images, namely moderate, severe, and extreme [7].

Diabetic automated retinopathy Extraction Use the FCM to remove pathological area using colour strength and domain information. Due to normalisedcolour intensities, histogram is then produced. The feature set is then removed and the entire area is eventually mapped by the density attributes, with the fuzzy c algorithm used to diagnose true diabetic retinopathy. Results from the simulation of the classifier produced 99.01% precision, 98.38% accuracy and 96.36% specificity. The efficiency of the proposed approach is also checked to be higher than the current methods [8].

Review On: The feature used in SVM and LDA is the Linear Discriminant Analysis (LDA), combined to increase the robustness of the blood vessel with disk array detection, by integrating SVM techniques and pre-processing. LDA is used as a blood vessel identification system for eye images, when blood vessels...
are clustered in a single category as pixels and other areas of the eye as off-pixels. The accuracy of this detection measured by analogy with the hand-drawn truths and findings of expert ophthalmologists is evaluated relatively using the MATLAB software [9] image processing toolbox for implementing this project. Automatic diabetic retinopathy detection using WORDS Approach Bag is used to create an automated word model with vector support machines. A small computational effort is used to investigate the leading cause of vision loss in adults, diabetic retinopathy. The solution proposed would provide a feasible, effective and time-consuming method for ophthalmologists to diagnose diabetic retinopathy. The term bag and the surfing attribute descriptor display outstanding discriminatory capacity with 94.4% accuracy. Many purpose detectors and descriptors will be incorporated in the system in the future, including ASIFT, HOG and LBP and more experiments. In addition, studies should be carried out to automatically measure the magnitude of diabetic retinopathy [10].

2. Methodology
Density-based clustering in image segmentation can be very effective. The pixels are also too small and too complex for macro regions to be measured. In the first two-stage solution, super-pixels from single pixels are computed. A super-pixel is a small cell in a grid of fully connected as well as unconnected local polygonal regions. In order to capture homogeneity in the zone, the set of all superpixels includes the whole picture and tests and adjusts the super-pixelation algorithms. It is a result of the fact that adjacent pixels are clustered into homogenous (super) broad pixels. A percentage (maximum weighted colour and spatial gap threshold) in the measurement of super-pixels of local homogeneities are calculated using strict parameters. A subsequent clustering density component of the procedure merges regions which exceed a certain threshold for their homogeneity. The Basic Linear Iterative Clustered (SLIC) algorithm can be used to construct superpixels. SLIC is a K-means method with the necessary number of super pixels specified by the parameter. Even in the first super pixels the centres of equal-area hexagonal cells would be k-means.

The algorithm then evolves iteratively by using k-means, which distorts the original cells according to the colour homogeneity into deformed polygonal regions. The end effect remains an unrelated amount of small, homogeneous, “deformed” colour regions covering the entire image. The CIELAB colour space instead of RGB is used to improve colour gap measurement. In order to better imitate human visual colour variations than many other colour fields, including RGB, CIELAB colour space has been developing. The most significant parameters for SLIC are the number of super-pixels K and r. The radius states that the regions are smaller than fused with the neighbouring regions. The original and average dimensions of the super pixel are N/K, where N is a pixel count in the image and k is a superpixel count. The effect of using SLIC with K = 3000 in an EFI image is seen in Figure 1. As certain lesions can be very small (e.g. micro-aneurisms), as seen in Figure 5.3 (K=15000), a larger number of super pixels is

![Figure 1. Block diagram of proposed system](image-url)
preferable because small structures can be isolated best. SLIC is on the other hand, computer-heavy, with K increasing its runtime.

Figure 2. (a) SLIC, k=3000  
Figure 2. (b) SLIC, k=1500

Figure 2(a) and 2(b) is ready for segmentation with DB Search, with super-pixelisation image density dependent clustering. DB Scan is based on three distinct density classifications of points: The main elements, the boundary points as well as the noise points. A superpixel is known as the core point if, at a distance of lower than r (radius), having at least a minimum number of "similar" points (min. Pts). Transitivity ensures that all the "density open" superpixels, centred on each dense chain (min Pts, r) connectivity, that is applied to the region, where a p point p is the superpixel of a region. It slows down the algorithm because any single point is to be analysed in DB Scan more than once. However, since to super pixels are used, the operation is much quicker than if the pixels were used. The outcome of the implementation of the DB scan of a particular threshold is seen in Figure2 (a).

DB search Groups the nearest ones in colour and space properties given a range of super-pixels. Since the colour of the microaneursis, Retinal haemorrhages including blot haemorrhages on one side as well as blood vessels on the other were close; the vascular tree should be identified before the procedure so as to confound blood vessels of the tree and DB Scan reddish lesions. The performance of this stage is seen in Figure 3, EFI without vascular tree. A Coye philtre is used to eliminate the vascular tree. Applies PCA to the pixel, chooses the B channel of the image (the one with the highest contrast), tests another variant of a grayscale, increases the contrast by applying and adaptive histogram equalisation (CLAHE: Contrast-Limited Adaptive Histogram Equalization), by iso data thresholding, calculates any black and white mask. The resultant areas are sorted by eccentricity, length and height of the axis (e.g. eccentricity of blood vessels above "e," rounder of candidate reddish lesions). The black and white mask of the obtained vascular tree is superimposed on the initial image.

Approaching the correct removal of the vascular tree also helps to evaluate other lesions on the tree itself, e.g. venous beading as well as venous looping. In order to not conflict with the identification of exudates, the Optical Disk shall be marked and removed. The optical disc is removed with Otsu algorithm.

3. Results and Discussions

3.1 Feature Extraction and Classification

Only statistical information on R, G, B and grayscale channels is obtained after noise has been removed
from every segmented area.

**Figure 5.** Results of proposed system

The mean, mode and standard deviations of the channel, kurtosis, maximum, and the statistics for each colour channel are low, distance, Axis as well as eccentricity, plus histograms of colour and texture. Multidimensional data collection is made up of all regions and that each region (normal, exudate, haemorrhaging, microaneurysis) has a data set for development. A classification is then generated using the algorithms of machine learning.

4. **Conclusion and Future Works**

As described above, the aim of this paper is to establish a method to distinguish patients with BDR and PDR, either from a colour picture or from the gray-level fundus image. Red spots and bleeding are the multiple diseases of diabetic retinopathy that are of concern during the BDR and PDR phases of the disorder. Whilst SDR forms should be referred to the eye doctor. Creation of a MATLAB based Visual User Interface (GUI) tool to label fundus images for the ophthalmologist. For present and future work the chosen images can be used for the creation of DR grading and database systems.

5. **References**

[1] Kumaran Y and Patil C. M, 2018, A brief review of the detection of diabetic retinopathy in human eyes using pre-processing & segmentation techniques, *International Journal of Recent Technology and Engineering*, 7(4), pp. 310-320.

[2] Jagdev G, 2018, Implementing processing and feature extraction of fundus images under diabetic retinopathy, *International Journal of Research Studies in Computer Science and Engineering*, 5(3), pp. 34-37.

[3] Jitpakdee P, Aimmanee P and Uyyanonvara, B, 2012, A survey on hemorrhage detection in diabetic retinopathy retinal images, *IEEE International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology*, pp. 1-4.

[4] Furtado P, Travassos C, Monteiro R, Oliveira S, Baptista C and Carrilho F, 2017, Segmentation of eye fundus images by density clustering in diabetic retinopathy. *IEEE EMBS International Conference on Biomedical & Health Informatics* pp. 25-28.

[5] Viswanatha, K. V, 2018, Automatic diabetic retinopathy detection using FCM. *International Journal of Engineering Science Invention* (IIESI), 7(4), pp. 19-24.

[6] Bachu, S, Priyanka Y. O, Raju V. B, and Lakshmi K. V, 2016, A novel approach for detection of motion vector-based video steganography by AoSO motion vector value. *In Innovations in Computer Science and Engineering*, pp. 225-233.

[7] KAMAL S, 2013, A security system employing edge-based rasterstereography, *International
Symposium on Biometrics and Security Technologies, pp.1-7.

[8] Islam M, Dinh A. V, and Wahid K. A, 2017, Automated diabetic retinopathy detection using bag of words approach, *Journal of Biomedical Science and Engineering*, **10**(5), pp. 86-96.

[9] Archana K, Mandeep, 2016, Diabetic ratinopathy analysis using SVM and LDA, *International Journal of Advanced Trends in Computer Applications* **3**(3), pp. 22-25.

[10] Naluguru Udaya Kumar, Ramashri Tirumala, 2017, Accurate detection of retinal tears based on neural network using fourier series power spectrum segmentation technique, *International Journal of Applied Engineering Research (IJAER)*, **12** pp.158-165.

[11] Naluguru Udaya Kumar, Ramashri Tirumala, 2015, A cross layer approach for feature extraction with accurate detection through blood vessel segmentation in automatic diabetic retinopathy, *Australian Journal of Basic and Applied Sciences (AJBAS)*, pp.524-534.