BLOOD VESSEL SEGMENTATION IN FUNDUS IMAGES

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Abstract - *To prevent blindness in earlier stage blood vessel segmentation is introduced based on Random Forest (RF).The modules used in the proposed system are Pre-processing, Segmentation, Lesion Identification, Feature Extraction and Classification.*

Detection of Microaneurysms and Hemorrhages are validated. The fundus image The performance of segmentation in this method is analyzed in terms of specificity, sensitivity and segmentation accuracy. The process of screening is evaluated on publicly available database: Diaretdb1 with the resolution of (1152 x 1500pixels).To extract the shape features Morphological image flooding is used. In this approach, candidate regions are first segmented using Nguyen et al. Line detection and Soares et al. 2D Gabor wavelet transform and then Feature Extraction is done by Dynamic Shape Features. Futher the classification process is carried out using Random Forest(RF).

Key Words: *Diabetic Retinopathy; Detection of lesion; Retinal Image; Optic disc removal; Dynamic Shape Feature; Random Forest(RF)*

1.INTRODUCTION

Several diseases like diabetes, cardiovascular disease, hypertension and stroke cause changes in the retinal vascular structure which leads to blindness. When the segmentation process is done manually by the trained experts it is very tedious and time consuming.

Diabetic retinopathy is a health issue which often leads to improper vision and in some cases it can even cause blindness. If it is treated at early stages loss of vision can be protected. Though this process more suitable treatment can be offered to the diabetic retinopathy affected patient . The research focuses on providing a computer aided telemedicine for diabetic retinopathy. The already adopted methods mainly focus on detecting microaneurysms. These can be detected using morphological actions. This automation can be achieved by testing a group of people affected with diabetic retinopathy and sorting out the people with more severity. This helps human experts to reduce the examination time of the disease. The fundus images with diabetic retinopathy have a part of the eye tissues which would be damaged already. This can be more accurately called as red lesion.

These red lesions at sometimes cause swelling in the retina, blood vessels called as microaneurysms and some time bleeding. In case of bright lesions a mass cell accumulation in the retina may occur and some fluffy patches may occur in the retina. The main aim is to differentiate micro aneurysms from stretched out structures .Microaneurysms are early signs of diabetic retinopathy however haemorrhages are even more valuable and useful to specify the severity of the disease.

1.1 EXISTING SYSTEM

Red lesions in the form of Microaneurysms (MAs) and Hemorrhages (HEs) are among the first explicit signs of diabetic retinopathy (DR). The diagnostic task in this is the lesion detection. A new curvelet based algorithm to separate these red lesions from the rest of the color retinal image, in order to prevent fovea to be considered as red lesion."A new illumination equalization algorithm" is applied. Digital curvelet transform (DCUT) is used in the next stage.

PROBLEMS IN EXISTING SYSTEM

- Does not segment the elongated structures.
- It did not perform well in the thin vessels it segments only thick vessels.
- It ignores useful information from shapes and structures.

1.2 PROPOSED SYSTEM

In the newly proposed technique the fundus image of the retina is given as an input. The fundus image is taken from the publicly available database **(Diaretdb1).** This method is split in to 6 different steps. The first step involves calibrating a single image against known values and the applying calibration to uncalibrated image. Second steps involves pre-processing of the image by giving a flat regular surface to the image which can be more collectively called as smoothing and this can also be alone by decomposing the image. Then the raised disc of the retina at the point of the entry of optic nerve, lacking visual receptor which creates a blind spot is also detected to eliminate this portion during the detection of lesions. The fourth step composes of identifying the people with diabetic retinopathy with corresponding lesions that are identified in the image pre-processing phase. The fifth step comprises of the dynamic shape features extraction. The final step is where the people gets affects with diabetic retinopathy are classified based on their red lesions using Random Forest(RF).

2. METHODOLOGY

1. Vessel Segmentation:

The segmentation task can be posed as an energy minimization problem in a conditional random field (CRF). In the original definition of CRFs, the respective images are mapped to graphical representation, where each pixel represents a node, and every node is connected with an edge to their neighbors according to a certain connectivity rule.

2. Lesion Detection:

Among the candidates, several regions correspond to nonlesions, such as vessel segments and remaining noise in the retinal background. To discriminate between these false positives and true lesions, an original set of features, the DSFs

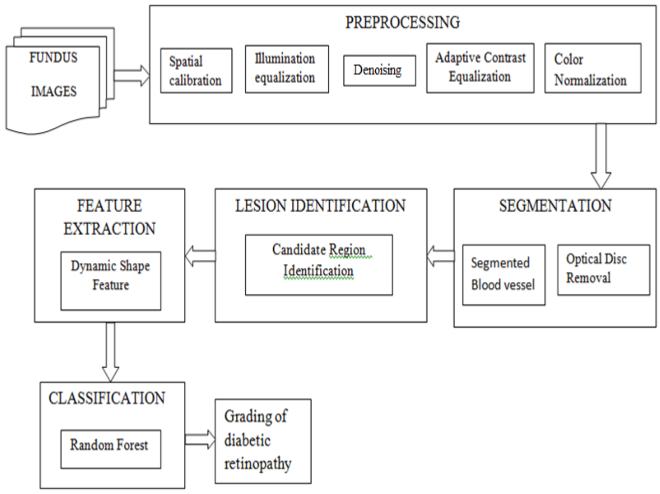

Fig -1:Architecture diagram

1.SPATIAL CALIBRATION

This method is very useful because it can adopt various resolutions of images. Here the image is neither increased nor decreased. Instead the diameter of the circular area surrounded by the black background i.e. the region of interest is taken with variation in their size. The diabetic retinopathy screening is obtained with a field of view at 45 where the diameter D is used to set different filter sizes. There are three parameters that are considered in this method they are

- d1 is the average radius of the optical disc
- d2 is the size of the smallest micro aneurysms
- d3 is the largest haemorrhage's size

In the obtained fundus we can set these parameters as

- d1 = D/10
- d2 = D/360
- d3 = D/28

2.IMAGE PROCESSING

The lighting of the retina is not uniform which often leads to local luminosity And variation in contrast .This image preprocessing can be done in 4 steps.

2.1 Illumination equalization

To overcome the reduction of an image brightness or saturation we use the illumination equalization method .A mean hm1 filter of diameter (d1) is applied on each colour component

That is present in the original image (I) to calculate the illumination of the image after this the produced image which is a colour image is subtracted from the original image.Then the intensity of the original image μ is also added

$$Iie=I+\mu-I*hm1$$

2.2 Denoising

In this method a small mean filter (hm2) of diameter (d2) is applied to each channel in the produced image Iie in order to reduce the noise that results from the steps which does not involve the smoothing of lesions.

2.3 Adaptive Contrast Equalization

The contrast continuous slow movement from one place to another is approximated by using a local standard deviation which is used to compute each pixel in the neighbourhood which is of diameter (d) for different colour channel (IAd) places which have low standard deviation indirectly denote that they are areas which have less contrast or which have smooth background to improve the low contrast area we sharpen the details in each portion using the below equation for each colour channel.

$$Ice=Idn+1/Istd(Idn*(1-hm3))$$

The details of the image produced in the phase are added to the image where the noise is removed

2.4 Colour Normalization

This step is necessary to obtain image of a standard colour range.

3.OPTIC DISC REMOVAL

The optic disc removal is a phase where the false positive in the red lesions need to be removed. In the pre-processed image we apply an entropy based technique to locate the centre of the optic disc. Usually the optic disc is present in the region where there is high intensity where the vessels possess maximum entropy.

4. CANDIDATE EXTRACTION

Usually the blood vessels and lesions which are dark possess high contrast in the green channel. The red channel and the blue channel are used in the latter part for the extraction of certain colour features. Especially in the green channel Micro aneurysms and haemorrhages appear as shapes which contain local minimal intensity. Less fortunately this method is very sensitive to noise.

To overcome this disadvantage we go for the dynamic transformation technique. In this technique the minimal regions are rated to their appropriate local contrast. The regions which are noisy usually have low contrast and lesions present. The extract and pre-processed image which is denoted as Gp. The main advantage of this method is that the out coming contrast measurement does not depend upon the size and shape of the regional minimum. Contrast and illumination equalization are very important because if these steps are not applied the global contrast and intensity thresholding will be difficult to calculate and the candidates whose distance to the optical disc's centre are smaller than the optical disc radius are removed.

5. DYANIMIC SHAPE FEATURES

In the diabetic retinopathy affected patients several regions correspond to non lesion region such as segments of vessels the flooding level in the topographic representation at each flooding level (i) for each person affected with diabetic retinopathy and catchment basin Bsji.

- **Relative area**(Rarea):number of pixels in Bsji, divided by total number of pixels in the region of interest
- **Elongation**(Elong):1-W/L where W is the width and L is the length of the bounding box of Bsji present along the major axis
- **Eccentricity**(Ecc):(L2-W2)/L2 with W and L the width and length of the bounding box Bsji present along the major axis
- **Circularity**(Circ): Ratio of the area of Bsji over it squared perimeter and multiplied by 4π
- **Rectangularity**(Rect): Ratio of the area Bsji over the area of the bounding box along the major axis
- **Solidity**(Sol): Ratio of the area Bsji over the area of its convex hull.

6. CLASSIFICATION

To differentiate between lesions and non-lesions we can use a Random forest classifier (RF).This classification is the most powerful technique in the recent years since it has number of advantages this technique can be applied to high dimensional and noisy data.

V. SOFTWARE AND HARDWARE SPECIFICATION

Software requirements include MATLAB 8.6 Version R2015b language for technical computing. It combines visualization, computation and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation.

Hardware requirements include Pentium Dual Core 2.00GHZProcessor.Hard disk of 500 GB and RAM of 2GB minimum.

VI. OUTCOMES

The expected outcome of the project is:

- Detection both MAs and HEs in eye
- Analysis of diameter and tortuosity of the vessels, classification of veins and arteries, calculation of the arteriovenous ratio.
- Automated or semi-automated segmentation methods would have improvements in efficiency and accuracy.
- Fast, readily available, highest spatial resolution.

VII. CONCLUSIONS

This method has strong performance in detecting both haemorrhages and micro aneurysms in the fundus for different image resolution. The results demonstrate its strong performance. Further the comparison between other techniques will be proposed as a future work.

VIII. REFERENCES

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