Cardiovascular Disease Prediction Using Graph Theoretical Approach

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Abstract- **The eye is sometimes said to provide a window into the health of a person for it is only in the eye that one can actually see the exposed flesh of the subject without using invasive procedures. That 'exposed flesh' is, of course, the retina, and the light sensitive layer at the back of the eye. There are a number of diseases, particularly vascular disease that leave tell-tale markers in the retina. The retina can be photographed relatively straightforwardly with a funds camera and now with direct digital imaging there is much interest in computer analysis of retinal images for identifying and quantifying the effects of diseases such as diabetes.A retinal image provides a snapshot of what is happening inside the human body. In particular, the state of the retinal vessels has been shown to reflect the cardiovascular condition of the body. Retinal images provide considerable information on pathological changes caused by local ocular disease which reveals diabetes, hypertension, arteriosclerosis, cardiovascular disease and stroke. Computer-aided analysis of retinal image plays a central role in diagnostic procedures. However, automatic retinal segmentation is complicated by the fact that retinal images are often noisy, poorly contrasted, and the vessel widths can vary from very large to very small. So in this project, we can implement automate segmentation approach based on active contour method to provide regional information using Lebesgue measure.**

Index terms-***Vessel, segmentation, local phase, Infinite perimeter, Active contour, fundus.***

1.INTRODUCTION

1.1Retinal imaging

Retinal image processing is greatly required in diagnosing and treatment of many diseases affecting the retina and the choroid behind it. Diabetic retinopathy is one of the complications of diabetes mellitus affecting the retina and the choroid. Retinal imaging is a recent technological advancement in eye care. It enables optometrist to capture a digital image of the retina, blood vessels and optic nerve located at the back of eyes.This aids in the early detection and management of diseases that can affect both eyes and overall health. This includes glaucoma, macular degeneration, diabetes and hypertension. With retinal imaging technology, the most subtle changes to the structures at the back of eyes can be detected. In this condition, a network of small blood vessels, called choroidal neovascularization (CNV), arises in the choroid and taking a portion of the blood.

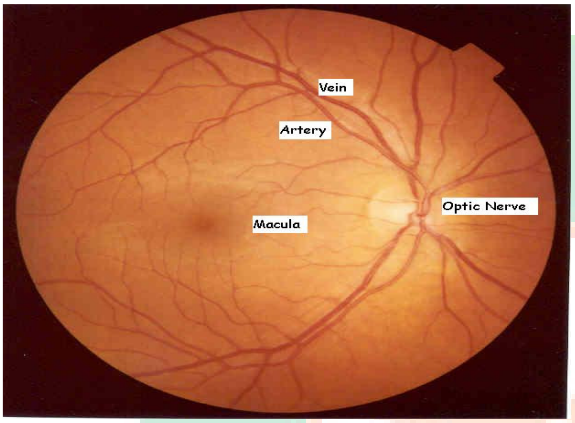
1.2 Retinal image analysis

Retinal images obtained using Adaptive Optics have the potential to facilitate early detection of retinal pathologies. Many researchers were working on retinal images to perform various image processing tasks for the beneficial of health sector. The result of image analysis relies on a preliminary phase of identifying good quality images, which have high contrast have proved the automatic assessment of quality of retinal images taken by fundal camera with a reference image. Recently, AO has been combined with scanning laser ophthalmoscope and optical coherence tomography (OCT) to obtain images of retinal microvasculature and blood flow and three dimensional images of living cone photoreceptors respectively. opening which consisted of erode followed by dilate is applied first. Erode function protects the small blood vessels by reducing their sizes while dilate function blows up the larger remaining.

1.3 Problem description

The automatic analysis of retinal fundus, a number of algorithms have been proposed for extracting the vascular structure and for identifying non-vascular lesion (exudates, haemorrhages, ischemic regions). The

first changes in the retina that point out the onset of a retinopathy, e.g. from a systemic disease, appear in the vessels. Changes in vessel structure can affected.



Retinal image analysis

II. EXISTING SYSTEM

The retinal microvasculature shares anatomical and physiological characteristics with the vessel structure in other parts of the human body. Some imaging techniques, such as retinographies, provide non invasive views of the blood vessels in the retina. Thus, the retinal images have become an excellent tool for the study and diagnosis of several pathologies related with alterations in the vessel tree. In this sense, numerous studies have reported that retinal micro vascular abnormalities, such as arteriovenous nicking, focal or generalized arteriolar narrowing and venular dilation, are related to different pathologies, such as hypertension and diabetes. all vessels as either artery or vein using existing vessel segmentation and some manually labeled starting vessel segments. The work closest to this one is an automated classification method in which the vasculature is segmented using a vessel tracking procedure and the vessel centerlines are detected. After defining an area of interest around the optic disc and dividing this area into four quadrants, color based features are extracted from the vessel segments that are then classified into arteries and veins using an unsupervised clustering method.

2.1 Description of the system

Existing system present a new unsupervised fuzzy algorithm for vessel tracking that is applied to the detection of the ocular fundus vessels. The proposed method overcomes the problems of initialization and vessel profile modeling that are encountered in the literature and automatically tracks fundus vessels using linguistic description like "vessel" and "non-vessel."

2.2 Retinal vessel segmentation using fuzzy c means clustering

Blood vessels shape and size are considered as indication to exist of diabetic retinopathy and its degree.
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III. PROPOSED SYSTEM

Examination of blood vessels in the eye allows detection of eye diseases such as glaucoma and diabetic retinopathy. Traditionally, the vascular network is mapped by hand in a time-consuming process that requires both training and skill. Automating the process allows consistency, and most importantly, frees up the time that a skilled technician or doctor would normally use for manual screening. So we can implement automatic process to examine the blood vessels to identify the cardio vascular diseases in retinal images. The proposed method utilizes the concept of active contours to remove noise, enhance the image, track the edges of the vessels, calculate the perimeter of vessels and identify the cardio diseases. Implement infinite perimeter active contour with hybrid region information (IPACHI) model to segment blood vessels and calculate perimeter of the blood vessels. Finally proposed an efficient and effective infinite perimeter active contour model with hybrid region terms for vessel segmentation with good performance. This will be a powerful tool for analyzing vasculature for better management of a wide spectrum of vascular-related diseases. Retinal vascular caliber (CRAE and CRVE) was analyzed as continuous variables. We used analysis of covariance to estimate mean retinal vascular caliber associated with the presence versus absence of categorical variables or increasing quartiles of continuous variables to predict the cardio vascular diseases.

3.1 Retinal based disease diagnosis

- Retinal image acquisition
- Preprocessing
- Vessel Segmentation
- Vessel classification
- Disease diagnosis

3.1.1. Retinal image acquisition

Retinal images of humans play an important role in the detection and diagnosis of cardio vascular diseases that including stroke, diabetes, arteriosclerosis, cardiovascular diseases and hypertension, to name only the most obvious. Vascular diseases are often life-critical for individuals, and present a challenging public health problem for society. Therefore, the detection for retinal images is necessary, and among them the detection of blood vessels is most important. The alterations about blood vessels, such as length, width and branching pattern, can not only provide information on pathological changes but can also help to grade diseases severity or automatically diagnose the diseases. In this module, we upload the retinal images. The fundus of the eye is the interior surface of the eye. which is generally expressed by the Arteriolar-to- also has multiple artifacts of distinct shapes and colors caused by different diseases.

3.1.2. Preprocessing

In this module, we perform the gray scale conversion operation to identify black and white illumination. Noise in colored retinal image is normally due to noise pixels and pixels whose color is distorted so implement sharpening filter can be used to enhance and sharpen the vascular pattern for preprocessing and blood vessel segmentation of retinal images performing well in preprocessing, enhancing and segmenting the retinal image and vascular patter. Human perception is highly sensitive to edges and fine details of an image, and since they are composed primarily by high frequency components, the visual quality of an image can be enormously degraded if the high frequencies are attenuated or completed removed. In contrast, enhancing the high-frequency components of an image leads to an improvement in the visual quality. Image sharpening refers to any enhancement technique that highlights edges and fine details in an image. Image sharpening is widely used in printing and photographic industries for increasing the local contrast and sharpening the images.

3.1.3. Vessel Segmentation

In this module, we can perform feature extraction and vessel segmentation steps using IPACHI model. It can create vascular network using active contour with Lebesgue measure with γ neighborhood function. We can extract the distribution model to restrict the shape range to an explicit domain learned from a training set. Finally we provide the segmentation mask for preprocessed retinal images.

3.1.4. Vessel classification

The segmented vessels are classified into arteries and veins. Correct classification of vessels is vital, because heart diseases affect arteries and veins differently. The alterations in veins and arteries cannot be analyzed without distinguishing them. After extraction of blood vessels, feature vector is formed based on properties of artery and veins. The features get extracted on the basis of centerline extracted image and a label is assigned to each centerline, indicating the artery and vein. First, each centerline pixel is classified into A or V classes, then for each label (Cij , j = 1, 2) in sub graph i, he probability of its being an artery is calculated based on the number of associated centerline pixels classified by LDA to be an artery or a vein. The probability of label Pa (Cij)= na Ci j / (Na Ci j + nvCi). Where na Ci j is the number of centerline pixels of a label classified as an artery and nv Ci j is the number of centerline pixels classified as a vein. For each pair of labels in each sub graph, the label with higher artery probability will be assigned as an artery class, and the other as a vein class. Finally, to prevent a wrong classification as a result of a wrong graph analysis, we calculate the probability of being an artery or a vein for each link individually.

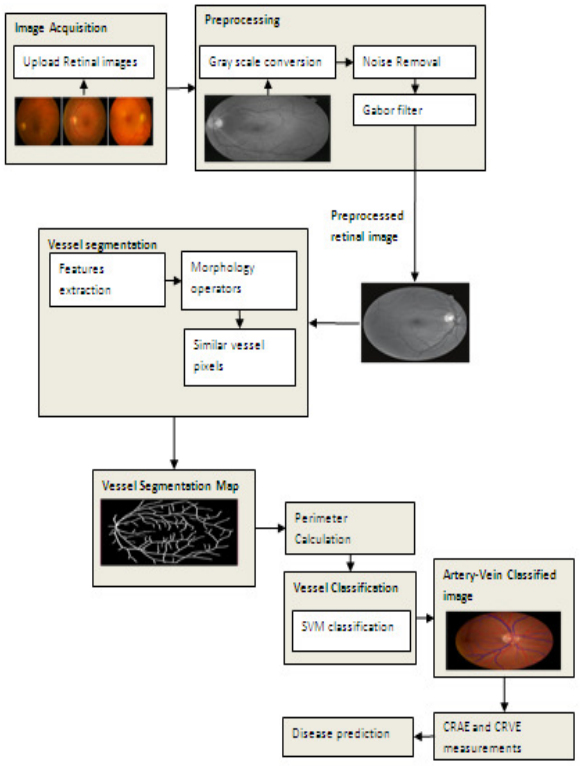
3.1.5DiseaseDiagnosis

In this module, we can diagnosis the diseases using AVR ratio based on CRAE and CRVE measurements. The vessel measurements CRAE, CRVE have been found to be correlated with risks factors of cardiovascular diseases and are positive real numbers The major systemic determinant for smaller CRAE is higher blood pressure whereas wider CRVE is mainly due to current cigarette smoking, higher blood pressure, stroke with odds ratios reported between 1.1 and 3.0.15,22,23 While in diabetes, an increase of CRVE is associated with increased incidence of diabetic retinopathy (DR), progression of DR, progression to proliferative DR and macular oedema, but is unrelated to CRAE.

IV.SYSTEM ARCHITECTURE

Retinal images obtained using Adaptive Optics have the potential to facilitate early detection of retinal pathologies. Many researchers were working on retinal

images to perform various image processing tasks for the beneficial of health sector.



V. ALGORITHM

5.1. Infinite perimeter active contour with hybrid region information (IPACHI) model

In this project, proposes a new method for segmenting piecewise constant images with irregular object boundaries: a variant of the region information where the length penalization of the limitations is replaced by the area of their neighborhood of thickness γ . The aim is to keep well details and irregularities of the boundaries while denoising additive Gaussian noise. The energy of the IPACHI model is:

$$F^{IPACHI}(\tau, r_n) = L^2(\gamma - \tau) + \sum_{n=1}^{N} \lambda_n R_n$$

Where L^2 the 2D Lebesgue measure is R_n is the nth region information and N is the total number of different region terms. The first term L^2 is the area of γ neighborhood of the edge set.

5.2. Support Vector Machine

Classification is done with the help of SVM classifier. In the recent years, SVM classifiers have established excellent performance in a variety of pattern recognition troubles. The input space is planned into a high kernel function in the feature space. And finally division is computed in the feature space to separate out the classes for training data. A global hyper plane is required by the SVM in order to divide both the program of examples in training set and avoid over fitting.

$$CRAE = 0.88 * (w_1^2 + w_2^2)^{\frac{1}{2}}$$

$$CRVE = 0.95 * (w_1^2 + w_2^2)^{\frac{1}{2}}$$

where $w_1, w_2,$ is a pair of width values. Then Artery vein ratio can be calculated as

$$AVR = \frac{CRAE}{CRVE}$$

VI. RESULTS

The proposed algorithm is implemented in MATLAB environment. The proposed system was constructed and tested using DRIVE datasets. Those databases are divided into training and evaluation dataset to assess the performance of the proposed method. Training database correctness of the system and is calculated as the sum of correct classifications divided by the total number of classifications.

$$\textbf{Accuracy} = \frac{\textbf{Classified Retinal Images}}{\textbf{Total Retinal Images}}$$

It is found that the proposed method detects classes successfully with accuracy of 85%.

VII. CONCLUSION

We conclude that, our proposed system implemented successfully with accurate identification of true vessels to obtain correct retinal ophthalmology measurements. And we implement the post processing step to vessel segmentation. This step is used to track all true vessels and find the optimal forest. We can

overcome wrong diagnosis of crossovers by using simultaneous identification of the significance of using structural information for A/V classification. Furthermore, we compared the preface of our approach with other recently proposed methods, and we conclude that we are achieving better results.

VIII. FUTURE WORK

The segmentation of the optic disc is an important step in the development of a retinal screening system. In future we present an unsupervised method for the segmentation of the optic disc. The main obstruction in the optic disc segmentation process is the presence of blood vessels breaking the continuity of the object. The blood vessels inside of the optic disc are used to give continuity to the object to segment. So proposed approach is based on the graph cut technique, where the graph is constructed by considering the relationship between neighboring pixels and by the likelihood of them belonging to the foreground and background from prior information. In existing method the optic cup and optic disc are segmented by creating mask manually and from that the glaucoma is detected. But its experimental result doesn't close to clinical CDR value. But in our proposed system, we don't need to select the OD and OC boundary by creating mask. The OD is the high intensity part of an eye. So we easily extract the disc boundary by ellipse fitting segmentation. Cup segmentation is much more challenging compared to disc segmentation due to the presence of high density vascular architecture in the region of the optic cup traversing the cup boundary and we can extend our work to suggest a novel method to improve and mine the retinal vessels. Finally, implement an accurate graph cut and ellipse fitting segmentation is performed using the result of preceding symmetry transformation as an initial.

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