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Disease Prediction Based on Retinal Images using Deep Neural Networks

G. Theivanathan[1], M. Pavithra[2], E.P.Shobana Devi[3], B. Pavithra[4]

[1]Assistant Professor, [2,3,4]UGStudent,

Dept. ECE, Velammal Engineering College Chennai, TamilNadu,(India)

ABSTRACT

Image processing and analysis methods are increasing importance in all fields of medical science because it is helpful to learn visual signs on. Retinal vessels are majorly affected by various diseases like diabetes, hypertensionand vascular disease. Blood vessels in the retina reflect the changes in the blood vessels of other parts of body like heart, brain, kidney etc. Blood vessels of retina are divided into two types they are arteries & veins. For diagnosis of various diseases, it is more important to first distinguish the vessels into arteries & veins. The largest arteries &veins are measured using CRAE &CRVE which is correlated with stroke& heart disease. Thus, wrong identification of vessels leads to wrong diagnosis of the diseases. Hence preprocessing steps are introduced to vessel segmentation using median filter algorithm. In this paper, our focus is calculation of Arteriolar-to-Venular diameter ratio(AVR) for the diagnosis of various diseases. Basedon the AVR value the type of stroke is identified.

Keywords: CRAE, CRVE,artery,median filter, neural network, vein.

I.INTRODUCTION

A design concept to medicine and biology for health care purpose is the Bio Medical Engineering (BME) Application.The field seeks to close the gap between engineering and medicine field. Retinal images of the humans play the most important role in the detection and diagnosis of many human eye diseases for ophthalmologist. Some disease such as diabetic retinopathy and vascular degeneration and glaucoma are very dangerous diseases that they can lead to blindness of the human eye if they are not detected in early time correctly. Therefore, the detection of the human retinal images is very necessary and among them the detection of the blood vessels is most important. The alterations about the human eye blood vessels such as length, width and thebranching patterns are very helpful to grade disease severity or automatically diagnose the diseases. Detection of various diseases in human eye fundus image using digital image analysis methods has large potential benefits where large number of image is examined in very less time and very less cost. Generally arteriolar and the venular narrowing which are related to the higher blood pressure levels of the human body, is generally expressed by arteriolar-to-venular diameter ratio(AVR). For the estimation of the arteriolar-to-venular diameter ratio which is essential used to classify the blood vessels that are arteries and veins, since the slight classification error in the human eye vessel can have larger influence on the final value. Arteriolar-to-venular diameter ratio can be comprised of two elements they are Central Retinal Arteriolar Equivalent (CRAE) and

Central Retinal Venular Equivalent(CRVE). These values which are beneficial in finding the disease such like hypertension and other vascular diseases. These kinds of diseases even change the vessel branching patterns, so that there is need to overcome the problems which occur due to the bifurcation, cut of vessel etc. however manual detection of blood vessels is much more difficult since the blood vessels in a retinal image are complex and with low contrast. Also, there are number of retinal images to detect a disease. As a result, reliable and automatic methods for extracting and measuring the vessels in retinal images are needed. The main goal of this paper is estimation of the average diameter ratio of arteries with respect to veins which is the strong parameter in the diagnosis of the various vascular diseases.

II PROPOSED SYSTEM

2.1.System Architecture

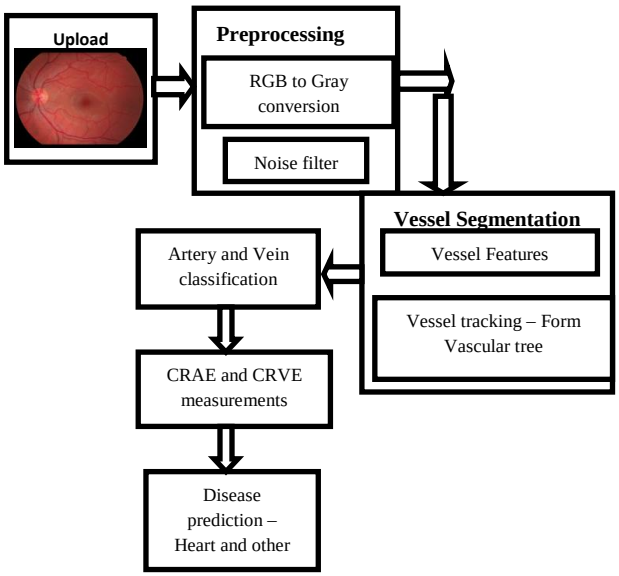


Fig.2.1 System Architecture

2.2. Modules

- Image acquisition
- Preprocessing
- Vessel Segmentation
- Vessel Classification
- Disease diagnosis

2.3. Image Acquisition

Retinal image is the microscopic image of human eye. User can upload the retinal images.

Image can be any size and any resolution. Based on retinal images, predict the diseases using blood vessels.

2.4. Preprocessing

Convert RGB image into gray scale image. Gray-scale image =

(0.3 * R) + (0.59 * G) + (0.11 * B).

Using median filter algorithm to eliminate the noises in images. Such noise reduction is a typical pre-processing step to improve the results of later processing.

2.4. Segmentation of Blood Vessels

From this module, we implement neural network mechanism of image processing. At first vessel values are tracked and pointed the vessel features.

Based on feature values, Back propagation algorithm is used.

2.5. Classification of Blood Vessels

Track the vessels and calculate the width of each blood vessel. Based on width values, categorize artery and vein vessels. And differentiate the vessels such as red represent as artery and blue represent as vein.

2.6. Disease Diagnosis

Calculate CRAE and CRVE measurements. Based on these above measurements, predict various diseases such as hyper tension, stroke, and blood pressure and so on.

III.MEDIAN FILTER

A grayscale is used in retinal image for determining the value of each pixel of a single image, in simple; it carries the information about intensity. In retinal imaging, it's known as "black-white" which is composed of exclusive shades of gray varying from black at weakest intensity to white at the strongest. Grayscale images(b) have many shades of gray in between.

Conversion in grayscale is not unique. Different weighting of colors represents in the image.

Fig.III(a) Fig.III(b)

In medical imaging, it is used for some kind of noise reduction on retinal image(b). It provides enhanced image. This type of noise reduction is typical a preprocessing step. In median filter, majority of the computational effort and time is taken for calculating median of each window. Since the filter must process every entry of the vessels and for large vessels such as images the median calculation efficiency is a critical factor to determine the speed of the algorithm and its run time capacity. Since in a given list of numbers only the middle value is required.

Median filtering is a nonlinear method used to remove noise from images. It is widely used as it is very effective removing noise while preserving edges. It is particularly effective at removing 'salt and pepper' type noise. The

median filter works by moving through the image pixel by pixel replacing each value with the median value of neighboring pixels.

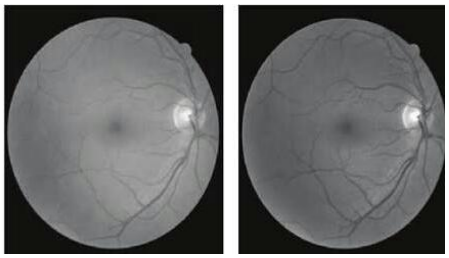
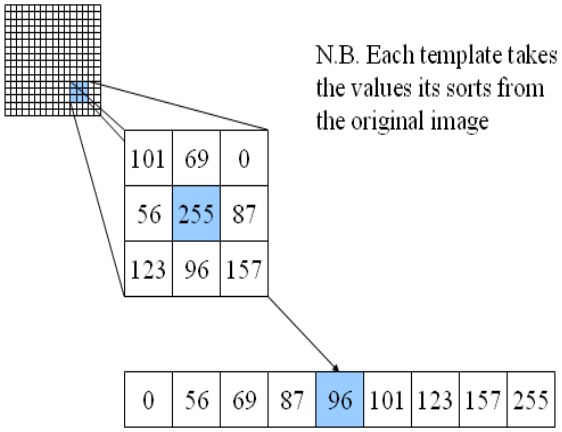


Fig.III(b) Fig.III (c)

The median is calculated by first sorting all the pixel values from the pattern of neighbors into numerical order, and then replacing the pixel being considered with the middle pixel values.



Median filter is one kind of smoothing techniques. All smoothing techniques are effective at removing noise in smooth patches or smooth regions of an image. This median filter is used to remove the high-level noise, like 'spackle noise and salt & pepper noise. Because of this, median filter is widely used in digital image processing.

TABLE II(a)Retinal Arteriolar Narrowing and 3-Year Risk of Coronary Heart Disease

Retinal arteriole to venular ratio	**Adjusted RR (95% CI) ***	
	Women	**Men**
1st quintile (range: 0.57-0.78)	2.2 (1.0-4.6)	1.1 (0.7-1.8)
2nd quintile (range: 0.59-0.82)	2.3 (1.1-4.8)	1.0 (0.6-1.7)
3rd quintile (range: 0.83-0.86)	1.6 (0.8-3.4)	1.2 (0.7-1.9)
4th quintile (range: 0.87-0.91)	1.3 (0.6-2.8)	1.2 (0.7-2.1)
5th quintile (range: 0.91-1.22)	1.0	1.0

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IV. NEURAL NETWORKS

It is a system of hardware and software patterned after the operation of neurons in the human brain, it is also called artificial neural network.

Image processing techniques use vessel segmentation method which is used to generate vascular tree in clinical imaging. It is widely demonstrated in ophthalmology. It enables external inspection of the condition and structure of blood vessels. The detection of arteries in ophthalmology is a basic procedure for the diagnosis of retinal pathologies, which are commonly seen and indicated in patients with diabetes and hypertension. Vision loss is an accurate identification for prevention of further deterioration. Pathologic progression is characterized by abnormal vascular arrangement in the eye. Segmentation of vascular tree forms the first step towards construction of an algorithmic basis for pathological detection. A DNN approach has been constructed of pixels for given image. It is a natural approach, for which heterogeneity in the roles of processing layer in the network required for recognizing different geometrical and spatial features of vessels.

Neural networks (also referred to as connectionist systems) are a computational approach, which is based on a large collection of neural units. Each neural unit is connected with many others, and links can be enforcing or inhibitory in their effect on the activation state of connected neural units.

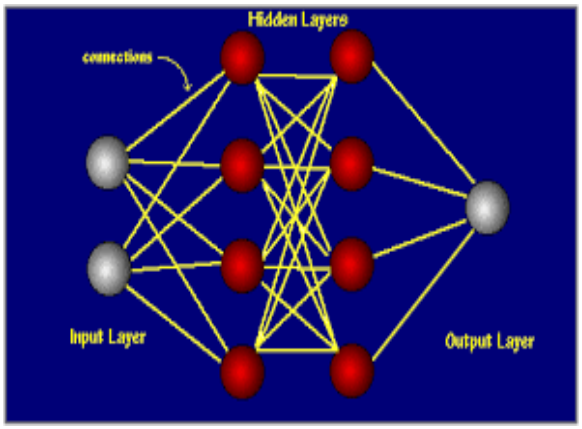

Fig. IV(a)

Neural networks (also referred to as connectionist systems) are divided into three layers

1. Input layer is defined as the various input such as image, in which vessel width are given.
2. Hidden layer is responsible for actual processing.
3. Output layer includes the processing of code in hidden layer we get a desired output.

4.1. Back Propagation

It is a common method of training a neural network in which the initial system output is compared to the desired output, and the system is adjusted until the difference between the two is minimized.

Back propagation neural networks employ one of the most popular neural network learning algorithms, the Back-propagation algorithm. It has been used successfully for wide variety of applications, such as image pattern and medical diagnosis. Back propagation is a common method of training artificial neural networks and used in conjunction with an optimization method such as gradient descent. The algorithm repeats a two-phase

cycle, propagation and weight update. When an input vector is presented to the network layer by layer, until it reaches the output layer

V. CONCLUSION

Retinal vascular structure measurements provide good diagnostic capabilities for the risk of cardiovascular disease. The wrong identification of vessels will lead to incorrect diagnosis. In the existing system Graph Tracer Algorithm is used to segment vessels. Graph tracer algorithm is not a perfect approach because there are bifurcations & cut-off of vessels. The proposed algorithm will focus on the use of a new gray image as input obtained from IR sensor scanner with the three RGB components. The median filter algorithm overcomes the drawbacks of graph tracer algorithm.

The proposed work will be extended to detect the age of the patient with the CRAE& CRVE measures using optic disk.

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