ISSN: 2278 – 909X
International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)
Volume 5, Issue 3, March 2016

Identification of Diseases in Retinal Blood Vessels using Principal Component Analysis

R.Rexoni Bindhya, C.S.Sree Thayanandeswari

Abstract— **Retinal blood vessel segmentation algorithm used for finding automatic retinal disease. Retinal vessel also helps not only identify disease but also used for diagnosing disease like Hypertension, Diabetic retinopathy, cardio vascular etc. In this paper we examine the principal component analysis methodologies in 2D retinal images provide in database. The aim of this paper is to analyze the feature points and find the Eigen value and Eigen vectors, find the co-ordinates of each data points in direction of principal component. The performance of techniques is compared and analyzed on two publically available databases of retinal images using true positive rate, false positive rate and sensitivity under ROC curves.**

***Index Terms*— Principal component analysis, Hypertension, Diabetic Retinopathy, Eigen vectors.**

I. INTRODUCTION

Hypertension and Diabetes (systematic disease) is a major cause of blindness in eye. The automatic vessel segmentation forms an important component of identifying automated eye disease [4]. Both eyes are affected by systematic disease. There are no early symptoms of disease. Typical symptoms of Hypertension Retinopathy are

- High cholesterol
- Over weight
- Diabetes

Symptoms of Diabetes Retinopathy are vision loss, blur eye. To classify the Hypertension Retinopathy [13]. There are 4 grades increase in severity. There is mild narrow in retinal artery and optic disc swelling in retina. The retinal artery that carry blood to retina it is blocked by blood clots. The retinal veins carry blood away from retina blocked by blood clots. In DR (Diabetic Retinopathy) [3] the retinal blood vessels are damaged, vision loss. Diabetes patients are 25 times more at risk for vision loss. In this paper analyze Principal Component Analysis to find the systematic disease (Hypertension and Diabetic Retinopathy) [12]. Retinal images classification using graph based approach for disease identification [1]

Manuscript received Mar, 2016.

R.Rexoni Bindhya ,ECE , Anna University/ PET Engineering College, Tirunelveli., ,India.
C.S.Sree Thayanandeswari, ECE, Anna University, Tirunelveli ,India,

described vessel segmentation to estimates the artery to vein ratio to measure the accurate vessel width .The automatic AVR accurately identify which vessels are arteries and which are veins. The graph based approach have been used for retinal image registration and vessel classification .In a/v classification have different properties and calculate differences size and quality. Finally a/v classification to analyze largest A/V it is reliable and assign the vascular alterations .The results are compared with three databases. Graph based approach for A/V classification of systemic diseases in retinal images [15] described a graph based approach for automatic A/V classification .The graph method is taken from retinal vascular to find graph nodes in vessel segments A/V .In features extraction and classification method to classify the retinal blood vessels. Finally compared with databases and achieves better results.

II. STRUCTURE OF PROPOSED WORK

In this paper, the method described a PCA identify the disease in A/V classification .The block diagram of proposed method for A/V classification. The main phases are 1) Graph Generation 2) Graph Analysis 3) Retinal blood vessel segmentation. The method extracts a graph from a vascular tree and makes a decision on each graph node. Based on graph node in each sub graph all graph links identify the particular vessel and labeled two distinct labels and finally classify the A/V and extracting a set of intensity features.

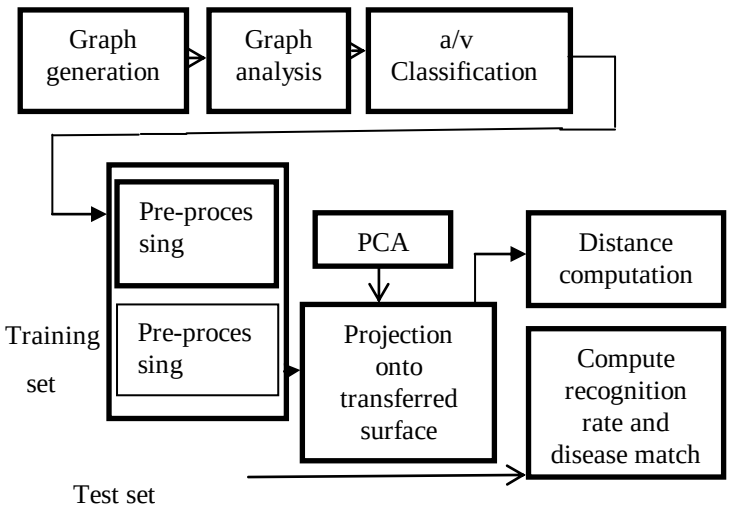


Figure 1: Block diagram of the proposed method for Disease Identification.

ISSN: 2278 – 909X
International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)
Volume 5, Issue 3, March 2016

III.GRAPH GENERATION

A graph represented for vascular network. In each node has intersection point in vascular tree and every link corresponds to the vessel segment between two intersection point.

A. Vessel segmentation

Blood vessels has different thickness are extracted from kirsch's template.

$$g^{(1)}=\begin{bmatrix}5&5&5\\-3&0&-3\\-3&-3&-3\end{bmatrix} \quad g^{(2)}=\begin{bmatrix}5&5&-3\\5&0&-3\\-3&-3&-3\end{bmatrix}$$

$$g^{(3)}=\begin{bmatrix}5&-3&-3\\5&0&-3\\5&-3&-3\end{bmatrix} \quad g^{(4)}=\begin{bmatrix}-3&-3&-3\\5&0&-3\\5&5&-3\end{bmatrix}$$

- Extract the retinal blood vessels from enhanced image using kirsch's template.
- Kirsch's template used 8 different orientation .This method involves spatial filtering for templates of different orientation followed by thresholding techniques.
- Variation in output image changing the value of threshold value.
- The boundary technique masking the redundant area. Extracting the blood vessels using edge detector for color images. In edge detection has 3 phases
  - In first phase, RGB image converted into gray scale image.
  - In second phase, edge detection mechanism for kirsch's method.
  - In third phase, given method checks the filtered result in given point threshold value to edge image.

B. Vessel Centreline Extraction

The centreline image is obtained by applying thinning algorithm in the result of vessel segmentation. Thinning algorithm removes the border pixel and object minimizes the connected strokes. The centreline image from vessel segmentation fig 3(b) shown in fig 3(c).

Thinning process uses a 3x3 four templates to scan the image.

i) Find the pixel location (i,j) where pixel image matches the T1 Template. In T1 template all pixel scan from top of the image are removed, moving from left to right and from top to bottom.

ii) The center pixel is not an end point and connectivity=1 marks the pixel for deletion.

iii) Repeat step1 and step2 for all location of pixel matching template T1.

iv) Repeat step 1 and step 3 remaining pixel location matching template T2, T3 and T4.

v) The white pixel marked for deletion.

C. Graph Extraction

The graph nodes are extracted from centreline image for finding the intersection points or end points. To Find the link between nodes, it removes all intersection points and their neighbors from centreline image result. Then image separate the components for vessel segments. The graph contain nodes and each node can be connected. The given link can only connect the nodes.

D. Graph Modification

In graph extraction there are any errors we go for graph modification. Common errors are splitting nodes, missing link and false link. Graph modification should eliminate the errors. It reduces the complexity of the graph analysis.

IV.GRAPH ANALYSIS

The output of the graph analysis decides the type of nodes. It not yet able to determine each label corresponds to artery class (or) vein class. The A/V classes assigned the sub graph only in last classification.

There are four different nodes

1) Connecting point: In connecting point, the blood vessel never cross or bifurcates and continuation nodes connecting different segments of same vessel.
2) Crossing point: In crossing point, two different types of vessel cross each other.
3) Bifurcation point: In bifurcation point, a vessel bifurcates into narrower vessels.
4) Meeting point: In meeting point, two different types of vessels meet each other without crossing.

Table: 1
Different cases of nodes and the possible types

Cases	Possible nodes
Nodes of degree 2	Connecting point Meeting point
Nodes of degree 3	Bifurcation point Meeting point
Nodes of degree 4	Bifurcation point Meeting point Crossing point
Nodes of degree 5	Crossing point

A. A/V classification

In A/V classification result we separate the artery and vein and specify the colours. Arteries classified in red and Vein classified in blue. In graph method with LDA outperforms the accuracy of LDA

classifier using intensity features for structural information in A/V classification.

V. PRINCIPAL COMPONENT ANALYSIS

In disease identification, the retinal images pre -processed (training set) features such as affected and non-affected regions. In test set has region extracted from A/V classifier images using PCA identified the pattern to reduce the dimension of dataset.

i) Find the co-variance matrix if variable same scale it is co-variance (or) large scale it is correlation matrix.

$$COV = 1/n \sum (X - \mu).(X - \mu)^T \quad (1)$$

ii) Find the Eigen value

$$(A - \lambda I) = 0 \quad (2)$$

.

iii) Find the Eigen vector in the direction of PC.

$$[A - \lambda I] * [X] = 0 \quad (3)$$

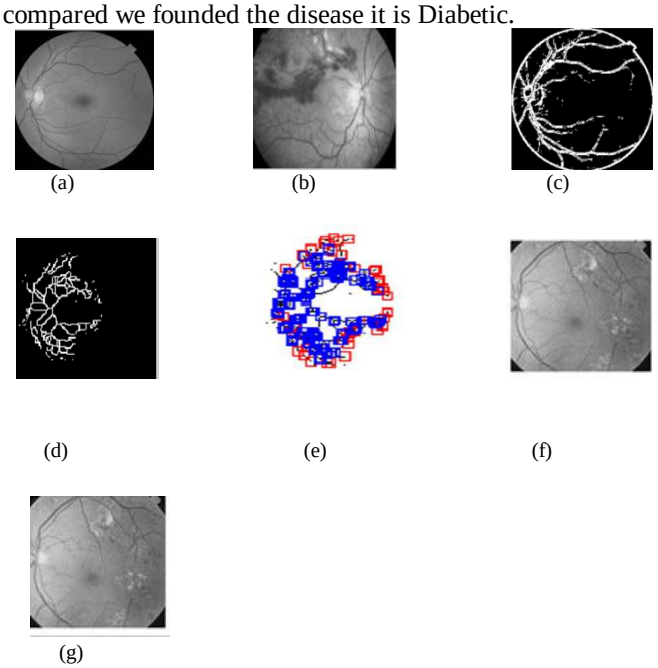
iv) Find the co-ordinates for each data points in direction of principal component.

$$PCj = ai1Y1 + ai2Y2 + ain\ Yn \quad (4)$$

Where 'aij' co-efficients for factor 'i' multiplied by the measured value for variable 'j'. PCA is used for identify pattern and find the similarity and differences in pattern. It has Maximum variance. Problem arise in high dimensional space and best in low dimensional. Space can be determined by best principal component.

VI.EXPERIMENTAL RESULT AND ANALYSIS

Thus the proposed method recognized the disease from extracted image using principal component analysis. PCA found the feature points and calculated the Eigen value and Eigen vector. Then trained image and test image are compared we founded the disease it is Diabetic.



(a) (b) (c)

(d) (e) (f)

(g)

Figure 2:Blood vessel segmentation of retinal image (a) Normal retinal image (b) input image (c) extraction of blood vessels (d) centerline image (e) graph extraction (f) test image (g) equivalent image.

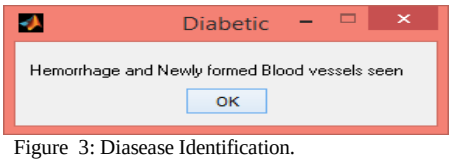


Figure 3: Diasease Identification.

VII.CONCLUSION

The principal component analysis is proposed in this paper to recognize the disease from extracted image. In database have many images using principal component analysis it converted the many images into single image and calculated the single value and at last compared with test image. Finally, found the disease average sensitivity 92%, average specificity 86% and average accuracy 95.6% in the retinal image.

REFERENCES

[1] K.S. Divya"Retinal Images Classifications using Graph based Approach for Disease Identification'', IJECS, Volume 4 Issue 4 April 2015.

[2] M. Divya, C. Senthamarai "Vessels classification in retinal images by graph based approach", IJRITCC, Volume 3, Issue 3, March 2015.

[3] L. D. Hubbard, R. J. Brothers, W. N. King, L. X. Clegg, R. Klein, L. S. Cooper, A. Sharrett, M. D. Davis, and J. Cai, "Methods for evaluation of retinal microvascular abnormalities associated with hypertension/sclerosis in the atherosclerosis risk in communities study," Ophthalmology, vol. 106, pp. 2269–2280, Dec. 1999.

[4] M. D. Knudtson, K. E. Lee, L. D. Hubbard, T. Y. Wong, R. Klein, and B. E. K. Klein, "Revised formulas for summarizing retinal vessel diameters," Current Eye Res., vol. 27, pp. 143–149, Oct. 2003.

[5] S. R. Lesage, T. H. Mosley, T. Y. Wong, M. Szklo, D. Knopman, D. J. Catellier, S. R. Cole, R. Klein, J. Coresh, L. H. Coker, and A. R. Sharrett, "Retinal microvascular abnormalities and cognitive decline: The ARIC 14-year follow-up study," Neurology, vol. 73, no. 11, pp. 862–868, 2009.

[6] G. Liew, P. Mitchell, J. Wang, and T. Wong, "Effect of axial length on retinal vascular network geometry," Amer. J. Ophthalmol., vol. 141, pp. 597–598, Mar. 2006.

[7] M. E. Martinez-Perez, A. D. Hughes, A. V. Stanton, S. A. Thom,
N. Chapman, A. A. Bharath, and K. H. Parker, "Retinal vascular tree
Morphology: A semi-automatic quantification," IEEE Trans. Biomed.
Eng., vol. 49, no. 8, pp. 912–917, Aug. 2002

[8] MedhaneDipakVinayak, M. S. Borse "Graph-Based Algorithm Differentiating Artery/Vein Registration of retinal images" IJETAE, Volume.4, Issue 12, December 2014.

[9] A. Mendonça and A. Campilho, "Segmentation of retinal blood vessels
by combining the detection of centerlines and morphological reconstruction,"IEEE Trans. Med. Imag., vol. 25, no. 9, pp. 1200–1213, Sep. 2006.

[10] Minakshee K. Chandankhede, Prof. Leena H. Patil "Graph Representation of Vessel Tree and A/V Classification Method for AVR Calculation On Retinal Images". IJARCET, Volume 4,Issue 5, May 2015.

[11] S.Sivakami, V.K.U. AhamedGani "SVM and graph based A/V classification in retinal images'',IJIRCCE,Volume.3, Issue 1,February 2015.

[12] J.Sivakumar, J.Jeno "Automated Extraction of Blood vessels in retinal images" IJAREEIE, Volume.3, Issue 3,March 2014.

[13] D. Siva Sundhara Raja, Dr.S.Vasuki, D.Rajesh Kumar "Performance analysis of retinal images blood vessel segmentation" An International journal (ACIJ),Vol.5,No.2/3,May 2014.

[14] C. Sun, J. J. Wang, D. A. Mackey, and T. Y. Wong, "Retinal vascular caliber: Systemic, environmental, and genetic associations," Survey Ophthalmol., vol. 54, no. 1, pp. 74–95, 2009.

[15] S.Tharangani, K.Malathi "Graph based approach for A/V classification of systemic diseases in retinal images'',JRRET, Volume 2, Issue 2, February 2015.

[16] Wong Li Yun,; U. RajendraAcharya,; Y.V. Venkatesh,; Caroline Chee,; Lim Choo Min,; E.Y.K. Ng ;- "Identification of different stages of diabetic retinopathy using retinal optical images" Information Sciences 178 (2008) 106–121184.

[17] Keerthi Ram, GopalDatt Josh;, and JayanthiSivaswamy,;- *"*A Successive Clutter-Rejection-Based Approach for Early Detection of Diabetic Retinopathy*"* IEEE TRANSACTIONS ON BIOMEDICAL ENGINEERING, VOL. 58, NO. 3, MARCH 2011.

[18] F. Zana and J. C. Klein, "Segmentation of vessel-like patterns using Mathematical morphology and curvature evaluation," *IEEE TRANS. MED. IMAGE*, vol. 10, pp. 1010–1019, July 2001.

[19] L. Zhou, M. S. Rzeszotarski, L. J. Singer man, and J. M. Chokreff, "The detection and quantification of retinopathy using digital angiograms," *IEEE TRANS. MED. IMAGE.*, vol. 13, pp. 619–626, Dec. 1994.

R.Rexoni Bindhya has done the B.E degree in Electronics and Communication Engineering in 2014 from Anna University and is pursuing M.E Communication System in PET Engineering College.

Sree Thayanandeswari received the B.E degree in Electronics and communication from Anna University ,Chennai, 2007 and M.E degree from Anna University ,Chennai, 2013. She is currently working as an Assistant Professor in the PET Engg college,Department of Electronics and Communication, Vallioor. Her research areas include digital image processing.