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GLAUCOMATOUS IMAGE CLASSIFICATION BY ADAPTIVE WAVELETS

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Abstract-- *Glaucoma disorder causes damage to human's optic nerve due to the increased pressure in the eye. In this paper, an efficient method for glaucomatous imageclassification is presented using Dual Tree M-band Wavelet Transform (DTMWT), Probabilistic Principal Component Analysis (PPCA) and Random Forest (RF) classifier. At first, DTMWT is applied to represent the fundus image in multi-resolution that contains lower and higher frequency components. The lower frequency components are reduced by PPCA and then classification is made by RF classifier. The device efficiency is reliably, sensitivity and precisely calculated. Results show that a maximum classification accuracy of 91%, sensitivity of 88%, and specificity of 94% are obtainedby PPCA based DTMWT features with RF classifier.*

Keywords— *glaucomatous image classification by adaptive wavelets*

I INTRODUCTION

Glaucoma super-pixel classification is described in [1] based on the optic disc and optic cup segmentation. Initially, the input image is enhanced by the contrast-enhanced histogram, and then centre surrounds statistics features are extracted. Support Vector Machine (SVM) is used as a classifier. Multiclass glaucoma detection based on novel fractal features is described in [2].On the basis fractal analysis, glaucoma features are extracted by the box-counting method using fractal dimension. The kernel-based SVM classifier is used for classification.

Glaucoma classification by local deep features is described in [3].A local deep neural networkand holistic classifier are used for prediction. A combination of deep multiple features is identified in [4] glaucoma. At first, region of interest is extracted from the input glaucoma image. The softmax layer and SVM classifier are used for classification.

The glaucoma screening approach is described in [5] by optic disc segmentation and textural features. At first, the input fundus images are segmented by textural information. The local binary pattern and other features like average, median, skewness, kurtosis, standard deviation and entropy features are extracted. The SVM is used for prediction. Automatic glaucoma assessment is discussed in [6] using from Optical Coherence Tomography (OCT) images.

Glaucoma detection by using colour and texture features is discussed in [7]. Color and texture characteristics from OCT images are extracted. Artificial neural network and SVM are used as classifier tools. Glaucoma detection using nerve fibre layer measurement and functional visual field points is discussed in [8]. Features are extracted

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by feature vector formed by RNFL and sap features. A tree, lazy meta and bayesian classifiers are used for classification.

In this study, a glaucomatous image classification system based on DTMWT, PPCA, and RF classifier is discussed. The rest of this paper is as follows: The methods and materials of glaucomatous image classification system are described in section 2. The experimental results obtained by the glaucomatous image classification system by RF classifier is describedin section 3 and conclusion is given in the last section.

II METHODS AND MATERIALS

DTMWT is applied to the input normal and glaucomatous image to represent in multi-resolution. The dimension of lower frequency components which are obtained by DTMWT decomposition is reduced by PPCA. The prediction of glaucomatous images is made by RF classifier.

2.1 DTMWT Based Feature Extraction

The extraction of more discriminant features is possible in DTMWT. The input normal and glaucomatous images are decomposed by Hilbert pair of wavelets. The M-band filter banks are made by dual decomposition. The mother wavelet (M-1) and scaling function is defined by a one-dimensional image space . M-band filter in two-dimensional spaces are separated by for corresponding wavelets.

2.2 Dimension Reduction by PPCA

PPCA is a dimensionality reduction technique that analyzes the data by lower latent space. When the data or multidimensional scaling values are missed, the PPCA is often used to recover these values.PCA extends the range of Principal Component Analysis (PCA). In some missed data values, PCA projections can be obtained. Probabilistic mixture values are obtained by multiple PCA. The latent variable models in PPCA have n-dimensional observation vector pto a corresponding n-dimensional vector of latent variables n. The linear relationship in PPCA is defined by,

$$p = Xm + \psi + \lambda \qquad (1)$$

where X is anm x n matrix that relates the variables in n to the latent ones, is defined by non-zero mean and is defined by noise parameter. In this work PPCA is used to reduce the lower frequency component which is obtained from the DTMWT feature extraction. The PPCA is also used in other fields like face tracking [9].

2.3 RF Classifier

A bunch of decision trees from randomly selected datasets is formed by RF classifier and it is defined by ,where l is an input vector, denoted as random split of independent vectors with the equal distribution . B is bootstrap of training images and these are built by different bootstrap samples. The RF algorithm for decision tree is given by,

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$$P(z) = 1 - \sum_{a=1}^{V} s^2\left(a/z\right) \qquad (2)$$

where for is probability of classes evaluation after node splitting. The RF classifier is used for the classification of normal and glaucoma images. RF classifier is also used in vehicle land mark detection [10-12].

III RESULTS AND DISCUSSIONS

A total of 50 images are chosen from the private data base for the performance assessment in both regular and glaucoma categories. The size of the image is 256x256 pixels. Figure 1 and 2 show the normal and glaucoma images from database.

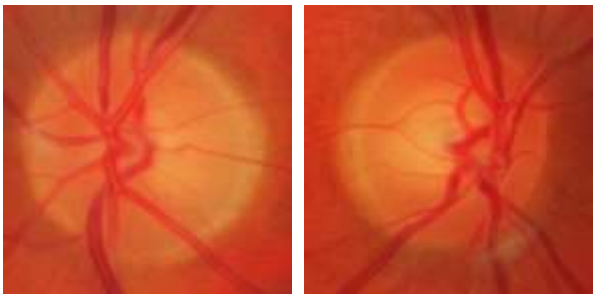

Figure 1 Sample normal images in database

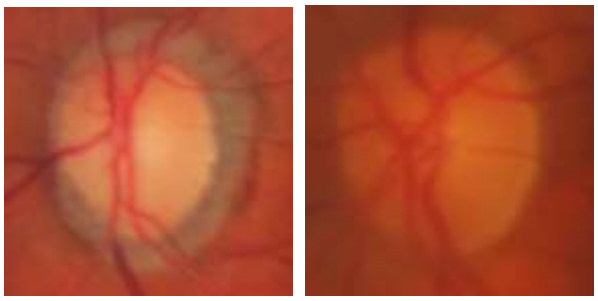

Figure2 Sample glaucoma images in database

The DTMWT is applied to input normal and glaucoma images, which produces different sub-bands that contains lower and higher frequency components. The lower frequency components are reduced by PPCA as it is the approximation of the original image. Then, the prediction is made by RF classifier. Precision, sensitivity and specificity for the DTMWT-based RF system are calculated. Table 1 shows the accuracy, sensitivity and specificity obtained from 1 to 4 levels of PPCA based DTMWT features with RF classifier.

Table 1 Performance of RF classifier

DTMWT Levels	Performance of RF Classifier		
	Accuracy (%)	Sensitivity (%)	Specificity (%)
1	75.00	70.00	80.00
2	73.00	74.00	72.00
3	81.00	78.00	84.00
4	78.00	74.00	82.00

It is observed in table 1 that the 81% of accuracy obtained by the PPCA features at 3rd level of DTMWT using RF classifier. Also, their sensitivity and specificity are 78% and 84%respectively.Figure 3, shows the performance of the glaucomatous image classification by PPCA based DTMWT features with RF classifier graphically.

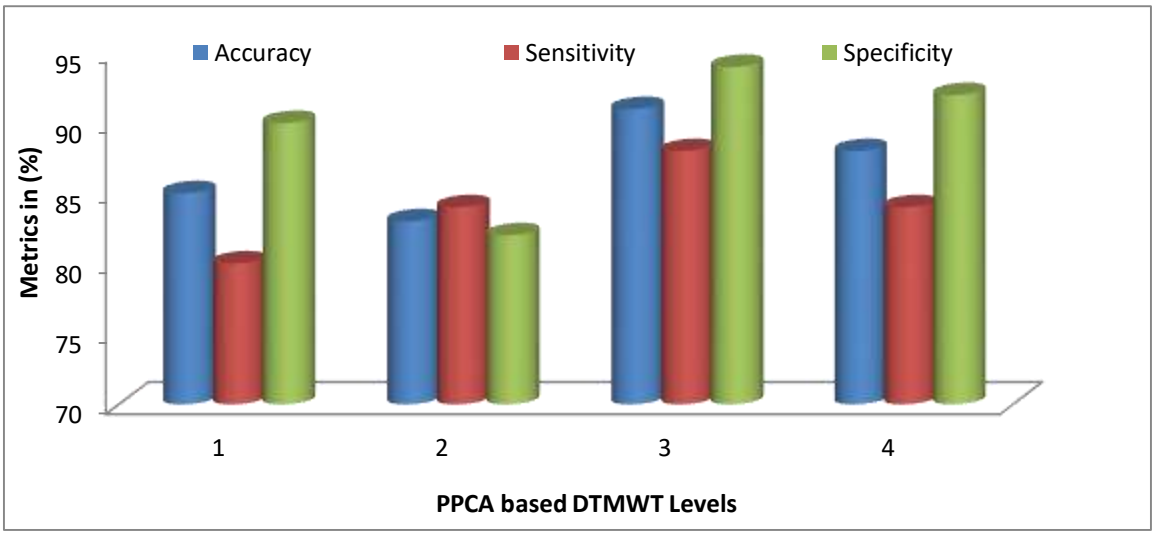

Figure 3Graphical representation of proposed system

IV CONCLUSION

An novel method for glaucomatous image classification using RF classifier is presented. The glaucomatous classification system uses DTMWT to represent the fundus image in multi-resolution.Different DTMWT decomposition levels are used for the representation. The sub-band coefficients contain lower and higher frequency components. The lower frequency components are reduced by PPCA which is a dimensionality reduction technique. Finally, the classification of reduced features is made by RF classifier. The experimental results show that the classification accuracy of 81% is achieved at 3rdlevel of DTMWT.

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REFERENCES

1. Cheng, J., Liu, J., Xu, Y., Yin, F., Wong, D.W.K., Tan, N.M., Tao, D., Cheng, C.Y., Aung, T. and Wong, T.Y., 2013. Superpixel classification based optic disc and optic cup segmentation for glaucoma screening. IEEE transactions on medical imaging, 32(6), pp.1019-1032.
2. Kim, P.Y., Iftekharuddin, K.M., Davey, P.G., Tóth, M., Garas, A., Holló, G. and Essock, E.A., 2013. Novel fractal feature-based multiclass glaucoma detection and progression prediction. IEEE journal of biomedical and health informatics, 17(2), pp.269-276.
3. Li, A., Cheng, J., Wong, D.W.K. and Liu, J., 2016, August. Integrating holistic and local deep features for glaucoma classification. In 2016 38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC) (pp. 1328-1331). IEEE.
4. Li, A., Wang, Y., Cheng, J. and Liu, J., 2018, April. Combining multiple deep features for glaucoma classification. In 2018 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP) (pp. 985-989). IEEE.
5. Joshi, A., Kadethankar, A., Patwardhan, V., Porwal, P., Pachade, S., Kokare, M. and Meriaudeau, F., 2018, August. Glaucoma Screening Through Level Set for Optic Disc Segmentation and Textural Features for Classification. In 2018 International Conference on Intelligent and Advanced System (ICIAS) (pp. 1-6). IEEE.
6. Gopinath, K., Sivaswamy, J. and Mansoori, T., 2016, April. Automatic glaucoma assessment from angio-OCT images. In 2016 IEEE 13th International Symposium on Biomedical Imaging (ISBI) (pp. 193-196). IEEE.
7. Pathan, S., Kumar, P. and Pai, R.M., 2018, September. The Role of Color and Texture Features in Glaucoma Detection. In 2018 International Conference on Advances in Computing, Communications and Informatics (ICACCI) (pp. 526-530). IEEE.
8. Yousefi, S., Goldbaum, M.H., Balasubramanian, M., Jung, T.P., Weinreb, R.N., Medeiros, F.A., Zangwill, L.M., Liebmann, J.M., Girkin, C.A. and Bowd, C., 2013. Glaucoma progression detection using structural retinal nerve fiber layer measurements and functional visual field points. IEEE Transactions on Biomedical Engineering, 61(4), pp.1143-1154.
9. Wang, T., Gu, I.Y., Backhouse, A. and Shi, P., 2008, October. Face tracking using Rao-Blackwellized particle filter and pose-dependent probabilistic PCA. In 2008 15th IEEE International Conference on Image Processing (pp. 853-856). IEEE.
10. Sedai, S., Roy, P.K. and Garnavi, R., 2015, April. Right ventricle landmark detection using multiscale HOG and random forest classifier. In 2015 IEEE 12th International Symposium on Biomedical Imaging (ISBI) (pp. 814-818). IEEE.
11. Maharaja D, Shaby M. Empirical Wavelet Transform and GLCM Features Based Glaucoma Classification from Fundus Image. International Journal of MC Square Scientific Research. 2017 Mar 27;9(1):78-85.
12. Shanmugan, K. (2017). GENDER CLASSIFICATION FROM THE IRIS CODE USED FOR RECOGNITION. International Journal of MC Square Scientific Research, 9(1), 218-229.
13. Babu, T.R., Devi, S. and Venkatesh, R., 2015. Optic nerve head segmentation using fundus images and optical coherence tomography images for glaucoma detection. Biomedical Papers, 159(4), pp.607-615.

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