Colour texture analysis of fundus image for glaucoma diagnosis using hidden Markov models

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Abstract:
Glaucoma is an eye disease category that affects the optic nerve, whose protection is important for good vision. It is typically caused by an abnormally high eye pressure. This is more widespread in older adults but can occur at any age. It will be treated early otherwise it leads to loss of vision. In this study, an efficient method for glaucoma diagnosis using hidden markov models is presented. Initially, the red, green and blue color components are separated. Finally, Hidden Markov Models (HMM) is used for glaucoma diagnosis. The experimental results and discussion shows the performance of the proposed system.
Keywords: Glaucoma diagnosis, Color texture analysis, Channel Seperation, Hidden Markov Models

Introduction:
Support Vector Machine (SVM) based glaucoma diagnosis is described in [1]. From input retinal image the Region Of Interest (ROI) and disk are detected. Then optic cup region are detected. Then optic cup boundary is smoothed. The disk height, level set based ellipse fitting and cup to disc ratio are detected. Retinal images based glaucoma detection is discussed in [2]. Then Principal Component Analysis (PCA)is used for glaucoma detection.

Glaucoma classification using retina images based on Independent Component Analysis (ICA) is discussed in [3]. The ICA and K-Nearest Neighbor (KNN) for feature extraction and classification. Glaucoma diagnosis based on focal edge detection is discussed in [4]. The input angle image is determined by quadrant. Then the focal edges are detected. Finally, grading is made.

Haralick texture feature based glaucoma diagnosis is described in [5]. The retinal image is pre-processed by gray level co-occurrence matrix. Prediction is made by KNN. Neural network based glaucoma classification is described in [6]. The texture features are used for feature extraction then PCA and statistical analysis method are used. The prediction is made by neural network classifier.

Texture feature extraction based glaucoma detection is discussed in [7]. The input images are given for extraction of red cannel and contrast adjustment. The ROI region is extracted by using Hough transform, morphological operation and k- means clustering technique. Finally, the prediction is made by SVM. Glaucoma detection based color and texture features is described in [8-9]. The input fundus image the channels are separated. Then the in-painting blood vessels are separated. Then the features like mean, standard deviation, skewness, variance, energy and entropy features are extracted also the texture features are extracted. Prediction is made by SVM and artificial neural network.

A novel method for colour texture analysis of fundus image for glaucoma diagnosis using HMM is presented in this study. The remainder of the paper is structured as follows: Section 2 explains the techniques and materials used to diagnose glaucoma. The results and discussion of experiments are listed in section 3.. The last section concludes the glaucoma diagnosis system.

Methods and Materials:

Initially, in the fundus input images the red, green and blue color components are separated. The separated color components are classified by using HMM. Figure 1 shows the implementation of proposed system.
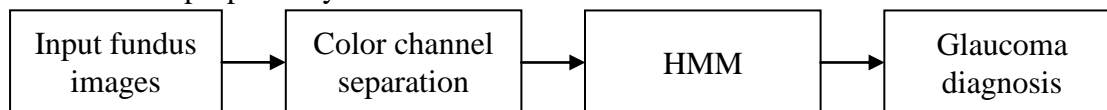
Input fundus images → Color channel separation → HMM → Glaucoma diagnosis

Figure 1 Glaucoma diagnosis using HMM

Color Channel Separation:

Digital color picture consists of pixels, and primary color pixels are made up a set up color combinations. In this relation, a channel is a gray image of a color picture the same size and consists of only one of the key colors. For example, a digital camera image will have a red, green and blue channel. There's only one channel for a grayscale picture. Channels are also referred to as raster bands in geographical information systems. Another closely related term is the use of neural networks in function maps. Initially, from the input fundus images the red, green and blue channels are separated. Then these channels are separately given to HMM for classification. Then the different color samples are extracted by Haralick features.

HMM Classification:

The status is clearly visible to the observations in simpler Markov models and thus the probabilities of state change are the only parameters while the status in the HMM is not seen directly, but the output is obvious according to the state. Each state has a probability distribution over possible output tokens. Therefore the tokens provided by HMM provide some information about the status sequence, also known as the model theory. Since these parameters are known precisely, the model is also called a HMM. HMM are particularly well known for their use in enhancement learning, and for the identification of temporal patterns such as voice, handwriting, gestures, voice component, musical score, partial discards and bioinformatics.

Results and Discussion:

At first, the fundus input images the red, green and blue color components are separated. The separated color components are classified by using HMM. Figure 2 shows the sample fundus image in the dataset.
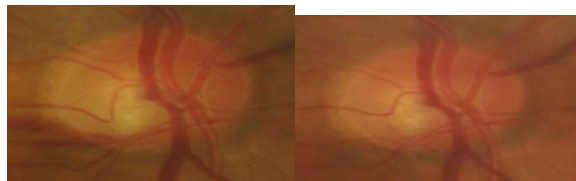
Figure 2 Sample images in database

The input fungus image is converted into grayscale. Then the red, green and blue color components are separated. Figure 3 shows the original image and red, green and blue color component images.
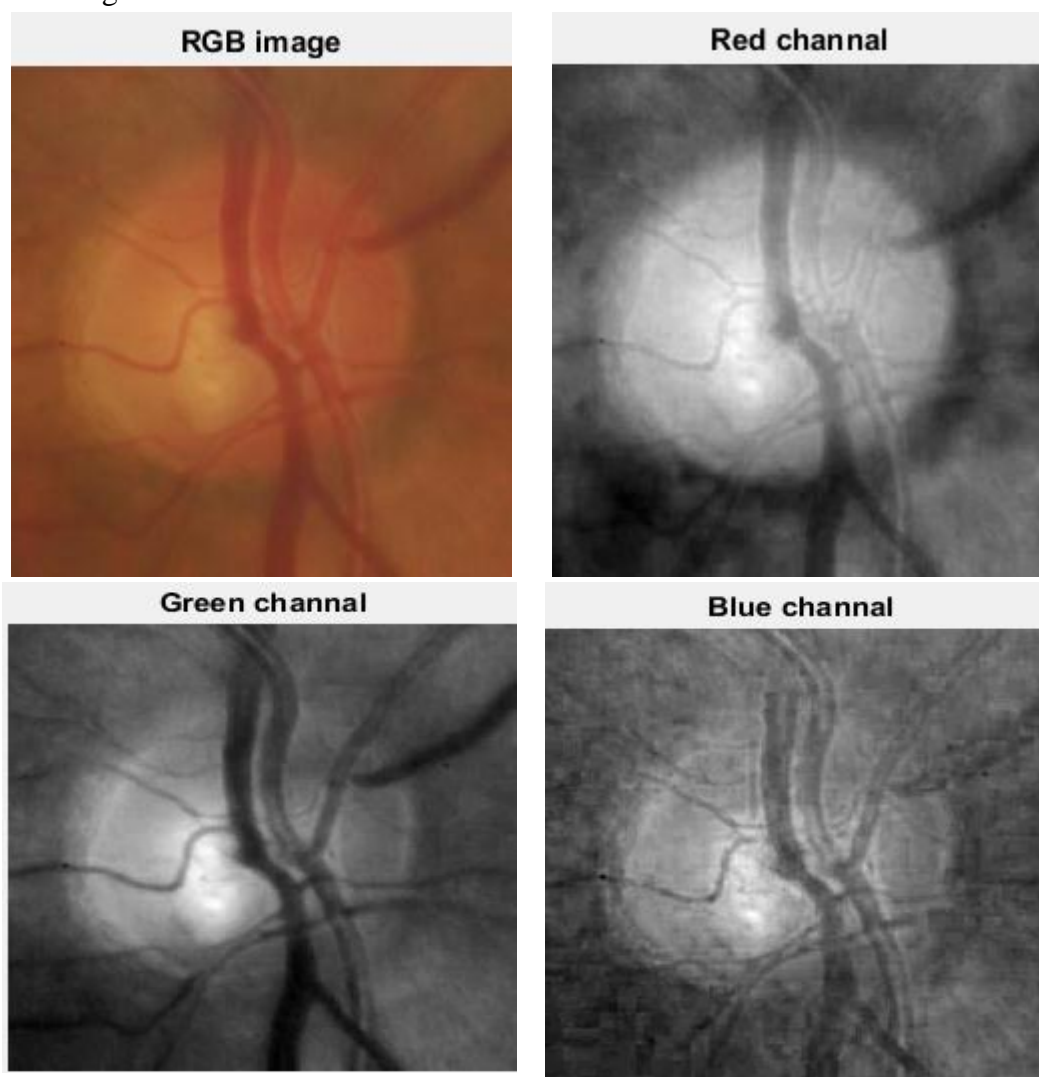
Figure 3 Red, Green and Blue channel separation

Haralick features extract the red, green and blue characteristics. The HMM model is used for prediction. The performance of HMM models are shown in figure 4.
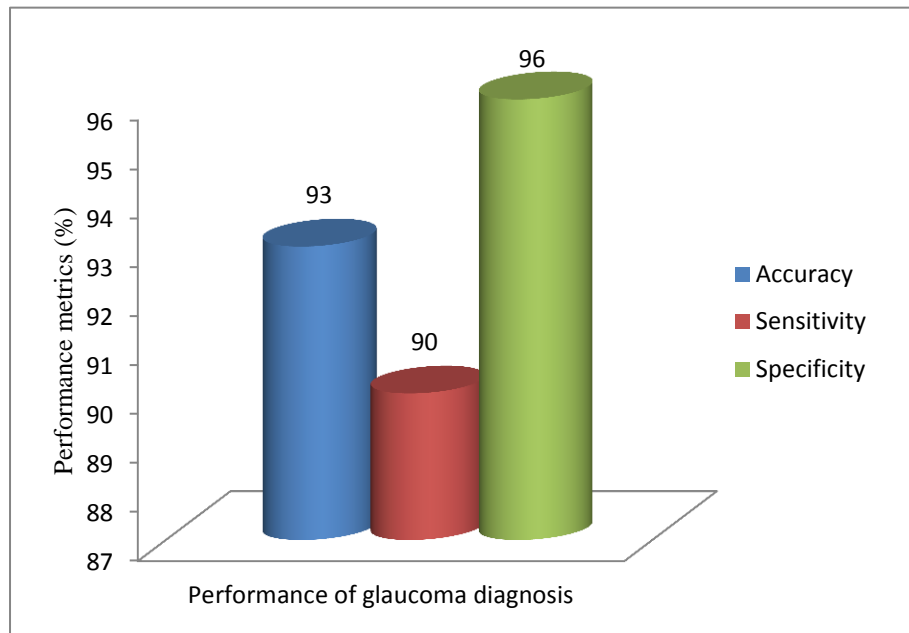

Figure 4 Performance of proposed system

From the figure stated above the classification accuracy of the method is clearly seen of 93% and its sensitivity and specificity are 90% and 96% by using color channel separation and HMM classifier.

Conclusion

An important colour texture analysis tool for the diagnosis of fundus images with HMM is discussed. The red, green and blue channels are initially isolated from the representations of the input fundus. Then the HMM classifier receives these different channels.. The system yields the classification accuracy of 93% and its sensitivity and specificity are 90% and 96%. The experimental results shows the better classification accuracy by using color texture analysis and HMM classifier.

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