Abstract

Retinopathy of Prematurity (ROP) is a developmental disease used to describe abnormal blood vessels and scar tissue growing inside and over the retina of the eye. Early symptom detection can prevent childhood blindness. Automated screening would be required, however general-method edge detection algorithms often fail to detect the optic disk (OD) due to fuzzy boundaries, inconsistent image contrast or missing edge features because , especially in case of infant, image acquisition process has to be very quick and in low light condition. This thesis presents algorithms for segmentation of optic disk boundary in low-contrast images based on 2D Circular Hough Transform, Principal Component Analysis (PCA), Active Contours (Snakes) and mathematical morphology. In 2D Circular Hough Transform, the number of dimensions of normal Circular Hough Transforms histogram is reduced from 3 to 2 dimensions based on an approximation of OD radius. First few circles are approximated by using maximum points from Hough space. A circle with the best fit to OD edge image is chosen. The results are validated with ophthalmologists' hand-drawn ground truth. This algorithm produces 81.7% accuracy with simpler computational complexity. In the PCA and Active contours (Snakes) techniques, the optic disk localization is achieved using segmentation by an active contour model (Snake) with gradient vector flow (GVF) as an external force and the first Snake is placed at a location very close to the center of the optic disk approximated by a PCA-based model. The algorithm is evaluated using 50 retinal images from infants with retinopathy of prematurity (ROP) condition. The results from the GVF method were compared with conventional optic disk detection using a 2D Circular Hough Transform and later verified with hand-drawn ground truth. The result is quite successful with the accuracy of 85.34 %. Another technique to detect the optic disk is to present an algorithm by using mathematical morphology. Histogram equalization and average filtering techniques were used to enhance Red band of the original low-contrast retinal image. The blood vessel was eliminated from the retinal image using the morphology closing. Optic disk localization is then achieved using optimized mathematical morphology and connected labeling. The result of 30 infant's retinal images with ROP condition were validated with experts' hand-drawn ground truth. The result is quite successful with the accuracy of 99.9 % for retinal images with ROP.