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A Survey on Localizing Optic Disk

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Abstract

Digital image of the retina is widely used for detection of patients suffering from sight threatening diseases such as Diabetic retinopathy and Glaucoma. Diabetic retinopathy is a stage of diabetes that can cause vision loss. The timely diagnosis and of these diseases can prevent lot people of severe visual loss .So there arises the need for automatic retinal image analysis system. Reliable and efficient automatic detection of features like optic disc, blood vessels and fovea in the retinal images are major tasks in an automatic screening system. This paper presents a survey of various techniques for Localizing Optic Disk appeared in literature survey.

Keywords: Diabetic retinopathy, Glaucoma, Optic Disk, Retina.

Introduction

Optic Disk is located about 3 mm to the nasal side of the macula and it is small spot on the surface of the retina, called blind spot. It is the point where the fibers of the retina leave the eye and become part of the optic nerve. Optic Disk is the only part of the retina which is insensitive to light. At its center the opticus marks the point of entrance of the central artery of the retina. Also called blind spot and discus nerve optics[1]. Optic disc detection is required as a prerequisite for the subsequent stages in many methods applied for identification of the pathological structures in retinal images.

The total number of people with diabetes is projected to rise from 285 million in 2010 to 439 million in 2030 [2]. Diabetic retinopathy causes1.8 million of the 37 million cases of blindness all over the world [3]. Diabetic retinopathy (DR) causes blindness to people of working age in industrialized countries.

So there arises the need of Automatic retinal image analysis system can detect of features like optic disc, blood vessels and fovea in the retinal images which further help the doctors for early detection of disease like Diabetic retinopathy and Glaucoma which can cause blindness.

This paper is organized in following sections, section 1 describes Introduction, section 2 discusses survey of Techniques of Localizing Optic disk and section 3 provides the conclusion.

Methods of Localizing Optic Disk

This section describes the various methods of localizing optic disk.

In [4] Ahmed et al. proposed a method for biometric authentication using semi-circular segment around retinal funds optical disc. It is noted that thickness and enmity of blood vessels are most prominent in close proximity regions around the optical disc nice blood vessels enter retina through optical disc. We use these spatial arrangements of blood vessels as blood vessels provides us with the uniqueness property. Images in RGB and Cyber color spaces are tested in two separate experiments. The first experiment (Exp-I) resulted in 84.2% accuracy sing RGB and in the second experiment (Exp-II), 89.2% accuracy was achieved, in Cyber color pace. The average time taken is 10.25 seconds.

In [5]. Heath et al. aims to compare methods available to correct the magnification of images that result from the optics of the eye. The methods composed are to identify errors, and source of error, of the methods. Methods—11 are applied to ocular biometry data from three independent cohorts. Each method used in this magnification was compared with the method of Bennett, which uses most of biometric data. The difference calculated between each method and Bennett's is the "error" of the method. The relation between the error and axial length, ametropia, and keratometry was found by linear regression analysis. Results are as follows Methods using axial length had the highest mean (+0.5 to +2.6%) and standard aviation (0.6 to 1.2%) of errors. Of methods using keratometry and ametropia only, the lithest earn (−1.4% to +4.4%) and standard deviation (2.9 to 4.3%) of errors was found for a new method described in this paper, and that used by the Heidelberg retina tomography (HRT). The highest mean error (+2.2 to +7.1%) was found for Littman's method. Littman's correction was arguer than the HRT's by 3.5 to 3.7%. The mean difference between the new and HRT methods and the "abbreviated axial length" method of Bennett is −1.3 to +2.0%. The error of the "keratometry and ametropia" methods calculated is related to axial length of ocular biometry. Conclusions—Methods using axial length are calculated as most accurate. The axial length method of Bennett has little difference from more detailed calculations and is appreciably more accurate than methods using keratometry and metropia alone. If axial length is unknown, the new and the HRT methods give results closest to the abbreviated axial length method.

In [6] Mudassar et al. proposed a technique named Principal component analysis (PCA).It is one of the techniques that have been applied for segmentation of the optic disc. A retinal image has the main components such as blood vessels, optic disc, fovea, and so forth the optic disc. In this paper, they are resenting the segmentation of optic disc and fovea using Scathe PCA which was trained on optic discs and foveae using ten retinal images and then it was applied on seventy retinal images which gave success rate of 97% in case of optic discs and 94.3% in case of fovea. Conventional algorithms eyed one patch at a time from test retinal image, and the next patch separated by one pixel part is Ed. Process is continued until the full image area gets covered. This process consumes much time. They are suggesting techniques to cut down the processing time of this technique by using binary vessel tree of an even test image. Results of validation of our idea are displayed.

In [7] Angel et al. proposed a methodology for locating the optic disc (OD) in digital retinal images is resented in this paper. Input images are intensity images (I channel of the HSI color space), seized to have a retinal diameter of 300 pixels. A shade-correction method for homogenizing the background, as a set of morphological open and close image operations for enhancement right structures, are applied to nod a pixel within OD. Evaluation was done on 1200 nude's images from the publicly-available MESSIDOR database, 229 of which present signs of ocular edema. In 1190 of these images the distance between the methodology-provided pixel and actual OD center position remained below one standard optic disc radius. These results outperform he re- vietheyd methodologies available in literature that they're tested on this same database.

In [8] Dehghani et al. proposes a new method for localization of optic disc in retinal images. The first step of most vessel segmentation is localizing the optic disc and its center. Disease diagnostic and retinal recognition algorithms are used. They use optic disc of the first four retinal mages in DRIVE dataset to extract the histograms of each color component. Then next step is to calculate the average of histograms for each color as template for localizing the center of optic disc. The DRIVE, STARE, and a local dataset having 273 retinal images are used for evaluation of the reposed algorithm. The success rate calculated was 100, 91.36, and 98.9%, respectively.

In [9] Arumugam et al. proposed a novel method for automatically locating the Optic Disc (OD). The extermination of the Optic Disc (OD) boundary is a fundamental step in the analysis of digital Diabetic Retinopathy (DR) systems. The proposed algorithm is mainly based on the K-Means clustering and Independent Component Analysis (ICA). In RGB color space, where R, G and B components are correlated. But in the new ICA color space three components are statistically independent and uncorrelated. Before segmentation of Optic Disc the blood vessels are extracted and removed by local entropy thresholding and in painting methods. The proposed method has been tested on a public datasets STARE and DRIVE which gave accuracy of 94.3% and 00%.

In [10] Yu et al. proposed a new, fast, reliable and fully automatic OD localization and segmentation algorithm. It was developed for retinal disease screening. First of all, with the help of template matching OD location candidates are identified. Then the template is designed to adapt to different image resolutions. By using vessel characteristics (patterns) on the OD are OD location is determined. Initializing the detected OD center and estimate the OD radius, a fast, hybrid level model is set, which combines region and local gradient, that is applied to the segmentation of the disk boundary. Morphological filtering blood vessels is used and bright regions other than the OD that affect in segmentation in per papillary region are removed. Optimization of the model parameters and their effect on the model performance are taken into consideration. Evaluation is done on 1200 images from the publicly available MESSIDOR database. The OD location methodology got the success rate of 1189 out of 1200 images (99% success). The average mean absolute distance between the segmented boundary and the reference standard is 10% of the estimated OD radius for all image sizes. Its efficiency, robustness, and accuracy make the OD localization and segmentation scheme described herein which is suitable for automatic retinal disease screening in a variety of clinical settings.

In [11] Sinthanayothin et al. aims to recognize automatically the main components of the fundus on digital color images. The main features of a fundus retinal image are defined as the optic disc, fovea, and blood vessels .Some methods are described for their automatic recognition and location. 112 retinal images undergo through preprocessing via adaptive, local, contrast enhancement. The optic discs are located by identifying the area with the highest variation in intensity of neighboring pixels. Multilayer perception neural net is used to identify the Blood vessels, for which the inputs are derived from a principal component analysis (PCA) of the image and edge detection of the first component of PCA. The fovea's are identified using matching correlation together with characteristics typical of a fovea—for example, which is the darkest area in the neighborhood of the optic disc. The main components of the image are identified by an experienced ophthalmologist. Results are evaluated after comparison with computerized methods. Results are—the sensitivity and specificity of the recognition of each retinal main component was as follows: 99.1% and 99.1% for the optic disc; 83.3% and 91.0% for blood vessels; 80.4% and 99.1% for the fovea.

Conclusion

This work shows various techniques used for localizing the optic disk. But all these techniques have drawbacks some of these techniques are difficult to implement and some are time consuming and some have high complexity. In most of the papers PCA approach is used which consumes more time. In many retinal images LoG filtering technique failed to detect OD clearly. So there is a scope of increasing the accuracy and efficiency of the system by combining two or three techniques together.

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