A Literature Survey on Glaucoma Detection Techniques using Fundus Images

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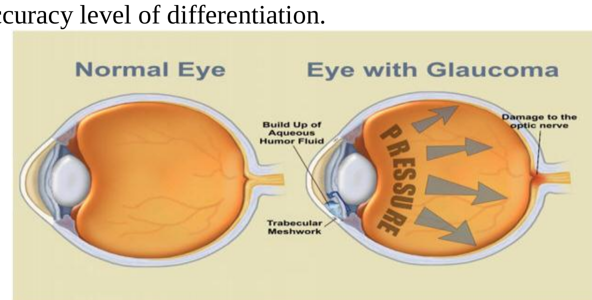
Abstract— Glaucoma is caused due to unawareness in people which can be resulted in to the blindness. For patients affected by this, mass screening can be the best curable solution which can help to extend symptom-free life. Using hybrid feature extraction from digital fundus images, we propose a novel low cost automated glaucoma diagnosis system. Higher order spectra (HOS), trace transform (TT), and discrete wavelet transform (DWT) features are used for automated identification of normal glaucoma classes. Vector machine (SVM) classifier with linear, radial basis function (RBF) and polynomial order 1, 2, 3 are the extracted features fed to support in order to select the best kernel for automated decision making.

Key words: Glaucoma, Higher order spectra, trace transform

I. INTRODUCTION

Glaucoma is caused by increased intraocular pressure (IOP) due to the malfunction of the drainage structure of the eyes. Glaucoma is an eye disease in which the optic nerve is damaged in a characteristic pattern. It is the second leading cause of peripheral blindness worldwide and results in the neuron degeneration of the optic nerve. It may be possible that the people having high eye pressure they never have damage and damage developed to the people having relatively low eye pressure, and that causes glaucoma. Untreated glaucoma can result to vision loss and permanent damage of the optic nerve, which over time can resulted into the blindness. It is estimated that by 2020 all over the world approximately 11.1 million people will suffer from bilateral blindness caused by glaucoma. Furthermore in India, it is estimated that approximately 11.2 million people over the age of 40 suffer from glaucoma and it is believed that these numbers can be curtailed with effective detection and treatment options. For the assessment of eye images, basically retinal image computational analysis techniques are used.

In order to detect these diseases at an early stage by differentiating glaucoma affected retinal image and a normal retinal image, we have proposed a novel approach to extract the energy signatures from the provided dataset using two dimensional discrete cosine transform and subject them to classification process. The texture features are obtained using three different wavelet filters and the selected features are subjected to two different classifiers to obtain higher accuracy level of differentiation.



[6]

In our existing system, Many computational techniques are available Automated clinical decision support systems (CDSS) in ophthalmology, such as CASNET/glaucoma are designed to create effective decision support systems for the identification of disease pathology in human eyes. These CDSS have used glaucoma as a predominant case study for decades by extracting structural, contextual or textual features from retinal images. For reducing the variability, that may be arrived due to different tracking progression of structural characteristics in the eyes by the clinicians, the retinal image analysis techniques are depending upon computational techniques. The structural and texture are the two category in which the features are extracted.

Proper orthogonal decomposition (POD) is another technique that uses structural features to identify glaucomatous progression. Pixel level information like location or region specific and the texture features is known as the spatial variation of pixel intensity. Glaucomatous image classification can also be done using texture features and higher order spectra (HOS) features.

The disadvantage of using textural features is that these are not bound to specific locations on the image thereby resulting in low accuracy and still to generate features to retrieve generalized textural and structural features from retinal images is difficult challenge.

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II. LITERATURE SURVEY

A. Automated Early Detection Of Diabetic Retinopathy Using Image Analysis Techniques [1]

In this paper, [1] with the diabetes, the common retinal complications are associated which knew as Diabetic retinopathy (DR). This is the major issue for any of the age groups for causing of blindness. Therefore early detection via timely screening and regular intervention, highly beneficial controlling effect of disease and for proper treatment. Since the ratio of people affected by the disease to the number of eye clinicians who can perform screening and intervention of these patients is very high, so we must need to have an automated diagnostic system. For further intervention and treatment by eye specialist, diabetic retinopathy changes in the eye so that only effected persons can be diagnosed.

Various aspects and stages of retinopathy are analyzed by examining the colored retinal images. Local distension of capillary walls can cause small scapular pouches and that appears as red small dots are Micro aneurysms. Hemorrhages can be caused due to their thin walls that can rupture easily. Hard exudates which deposits as yellow lipid, from which bright yellow lesions get appeared. The optic disk is the blood vessels emanate by the bright circular region. The center of the retina is defined as the fovea, and highest visual acuity the region. The fovea can be used to determine the severity of diabetic retinopathy, especially in relation to the hemorrhages and micro aneurysms and spatial distribution of exudates.

The optic disc is localized exploiting its high grey level variation. If there are only few pathologies, this approach has been potential to work well, like exudates that are also well contrasted and also appear very bright. For the detection of the contours, no such method is proposed. The optic disc is localized exploiting its high grey level variation. If there are no or only few pathologies like exudates that also appear very bright and are also well contrasted, this approach has been shown to work well. For the detection of the contours, no such method is proposed. The infrared and argon-blue images in the Hough transform are used to detect the optic disc's contours. Back tracing the vessels to their origin is used to localize the optic disc. To find the boundary of the optic disc, active contours and morphological filtering techniques are used. A threshold area was used to localize the optic disc and to find its contours, the watershed transformation is used. By classifying each image pixel by vessel or non-vessel, based on the pixel's feature vector, we can produce segmentation. Two-dimensional Gabor wavelet transform responses taken by multiple scales and the pixel's intensity are used to compose feature vector. For the detection of the optic disc, we need to find the approximate position and then the exact contours which are determined the watershed transformation. The use of multi-scale amplitude-modulation frequency modulation (AM-FM) methods for discriminating between normal and pathological retinal images has been proposed.

B. Detection of Hard Exudates And Red Lesions In The Macula Using A Multiscale Approach [2]

In this paper [2], they present an automatic system to detect pathologies on the sunspot like hard exudates micro aneurysm, and hemorrhages. They use the bottom up approach in which they tries to capture each unnatural structure in the macula which is used to observe DR lesions. This technique starts by extinguish the non-uniform illumination thereby raising the contrast of red lesions in the images. Possible DR lesion candidates on the macula are draw out by using amplitude-modulation frequency-modulation (AM-FM) features. AM-FM features are used for extract texture information from different frequency scales, providing for an effectual method for the detection of hard exudates and red lesions.

1) Pre-processing:

For red lesion detection the detection of red lesions, the images are preprocessed following a three-step approach. First, we apply illumination correction using a shade correction technique. Second, non-overlapping windows of 30x30 pixels are selected from the image, the bright pixels are detected and then they are replaced by the mean average value of the remaining pixels in that window. To find the optimal threshold for selecting the brightest intensity pixels, the second derivative of the histogram of the intensity pixel values is calculated.

2) Amplitude-Modulation Frequency-Modulation:

Amplitude Modulation-Frequency Modulation (AMFM) represents an image in terms of its instantaneous amplitude and instantaneous frequency components. In terms of textural features, for each component, three estimates of the AM-FM outputs are used: instantaneous amplitude, instantaneous frequency magnitude (IFm) and angle (IFangle).

3) Parameter Optimization:

Estimates of the IA, IF magnitude, and IF angle are calculated for the 13 different combinations of scales. Thus, a total of 39 different AM-FM feature images are obtained for each image. From them, binary maps are created by threshold, the generated AM-FM feature images.

4) Color constraint:

Color constraints are applied to the AM-FM binary output using a sliding window of 100x100 pixels. The bright pixels that are higher than the 95th percentile of the content of this window are maintained for the bright lesion detection. For red lesions detection, the threshold was set to the 7th percentile.

5) Extraction of features:

Sixty-four features are used to characterize each of the possible candidate objects in order to determine its type. By using the pixel information of each candidate, we extracted 3 types of features: 1) Color information within the candidate and a neighborhood of pixels outside the candidate, 2) Shape, and 3) Texture information using gray level concurrence matrix.

6) Classification:

The features obtained in Section E are the inputs of a linear regression classifier based on partial least squares (PLS).

C. Retinal Image Analysis To Detect And Quantify Lesions Associated With Diabetic Retinopathy [3]

In this paper [3], it concentrates only in the automatic detection of one of the lesions associated with DR: hard exudates. They normally appear in the fundus photographs as small yellow white sports with crisp margins and different shapes. Among DR lesions, exudates are frequently occurring early lesions.

An automatic method to detect hard exudates, a lesion related with diabetic retinopathy. The algorithm are found by using a statistical classification. The blood vessels are metameric applying the matched filter method which is described in to raise blood vessels and threshold the image obtained.

The sensing of this sort of objects is carried out performing color segmentation based on the statistical classification method represented. This method establish on the fact that if a group of features tin be defined so that the objects in an image map to non-convergent classes in the feature space, then they can easily place various objects classifying them into related classes.

It measured the primary signs of DR: hard exudates for an automated detection scheme. This was known by its color, using a statistical classification, and its acuteness of its edges, applying a Kirsch operator. After applying their method to 20 fundus pictures, the detection sensitivity for the hard exudates.

D. Automatic Detection of Hard and Soft Exudates In Fundus Images Using Color Histogram Thresholding [4]

In this paper [4], the precise and automated characterization of anatomic structures from image data sequences is one of the lasting issues and there is a faster increase the interest in the research community to research on Automatic Detection of Hard and Soft Exudates in Fundus Images Using Color Histogram Threshold. Diabetic retinopathy is considered as the root cause of vision loss for diabetic patients.

However, blindness can be avoided by earlier identification of symptoms and proper treatment by regular screening. Modern image processing techniques are used for detecting the existence of symptoms and abnormalities in the retinal images produced during the screenings in order to lessen the cost of these screenings. Exudates can possibly be quantified automatically, which are a major indicator of diabetic retinopathy that. Automatic identification of diabetic retinopathy exudates in color fundus retinal images is the main aim of this paper.

By using image processing techniques, a series of experiments are done for classification of hard and soft exudates is performed. Initially the color fundus retinal images are used to preprocessing for mathematical morphology and Fundus region detection using binary and CIELab color space conversion respectively. Subsequently, lesion boundary criteria pixels and to encapsulate the variation in exudates, nonlinear diffusion segmentation is employed.

For preventing the optic disc which is interfering with exudates detection, by the color histogram and aid of region props, the optic disc can be localized. With the aid of threshold color histogram, the exudates can be detected, which is used to classify the hard and soft exudates pixel from the color fundus retinal image.

Experimental evaluation on the publicly available dataset DIARETDB1 demonstrates the improved performance of the proposed method for automatic detection of Exudates. By comparing the hand-drawn ground-truths of an expert ophthalmologists, validation of the automatically detected exudates are done. Sensitivity, Specificity and Accuracy are used to evaluate overall performance.

E. Fast Detection Of The Optic Disc And Fovea In Color Fundus Photographs [5]

In this paper [5], they used a fully automated fast method to observe the fovea and the optic disc in digital color pictures of the retina is presented. In this method they make few premises about the location of each and every structure in that image. They specify that a retinal image problem of localizing structures is a regression problem. A KNN regressor is employed to call the distance in pixels in the image to the object of involvement at any given location in the image based on a set of features measured at that location. The method unites cues measured instantly in the image with remind derived from a segmentation of the retinal vasculature.

They suggest explicating the problem of finding a certain position in a retinal image as a regression problem. A KNN regressor is trained to approximation the distance to a certain location in the optic disc and the fovea as given a set of measurements obtained around a circular template placed at a certain location in the image.

1) Pre-processing:

Each of the images is pre-processed before the localization of the optic disc and the fovea commences. First the FOV is detected by calculating the gradient magnitude of the red plane of the image.

2) Position Regression:

We propose to define the problem of locating anatomical structures in retina images as a regression problem.

3) Vessel Analysis:

The local orientation and width of the retinal vasculature provide important clues to the position on the retina.

4) Template Based Feature Extraction:

There are many different independent variables (i.e. features) that can be measured in a retinal image and that may give information about the location in the image where one is measuring them.

5) Training Phase:

- Extraction of Training Samples,
- Selection of k,
- Regression Feature Selection,

6) Search Strategy:

No assumptions about the position of the optic disc and fovea in the retinal image are made. However, we do make a strong assumption about the location of the fovea with respect to the optic disc.

III. CONCLUSION

The present survey illustrates various methods and techniques used for Glaucoma Detection. Glaucoma represents pathology of multifactorial etiologic, so set up an objective alteration in the various diagnostic tests that represents the principal element for the performance of a certain diagnosis of glaucoma. In this survey illustrates the demerits of this methods and technique. To overcome this demerits and apply a new technique and methods to improve the diagnosis of glaucoma detection result.

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