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DETECTION OF GLAUCOMA BASED ON OPTIC DISC AND OPTIC CUP SEGMENTATION USING SLIC SUPERPIXELS

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Abstract

The Glaucoma disease that occurs in eyes and cause blindness. Glaucoma can be recognized in time but it is difficult toget cured. This disease affects the head of the optic nerve that margins to the vision loss. So the only way to prevent the disease is the early detection and the treatment. Now a day's several complications of the people have been solved using various technology and new ideas. This is one of the eye diseases which damages the cells present in retina and damages the vision and leads to blindness. Most of the people suffer from vision loss because of Glaucoma.

Glaucoma can be cured if it is detected on time and Intraocular pressure (IOP) is used for the detection of this disease at present, but it is less effective for the screening process of Glaucoma. On the center of surrounded statistics the classification of Super pixel is performed by the Segmentation of the Optic Disc with the use of histograms as Non disc or Disc. The performance of the location information, the Segmentation of the Optic Disc is boosted by the Segmentation of the Optic Cup. The intraocular pressure (IOP) is not effective and it is difficult to detect glaucoma based on population. The damaged head of the optic nerve assessment for visual field testing or IOP measurement is used as a base for the advanced detection method. Segmentation of the Optic Cup for Glaucoma screening and optic disc based super pixel classification is presented on this paper. Based on the current methods the assessment of the head of the optic nerve in the images of retinal funds is based on superpixel segmentation. Computation of the cup to disc ratio of the glaucoma screening is done by the optic cup and the optic disc that is segmented. Then for a patient the glaucoma is analyzed by the Cup to Disc ratio (CDR) camera image of the retinal funds which act as a fundamental reason to detect the disease. The optic disc segmentation and segmentation of optic cup by the use of super pixel classification is proposed in this paper for the purpose of screening the glaucoma. The two data sets of 0.822 and 0.800 are obtained by this method proposed and the development of the screening and the automatic segmentation is enhanced clinically by the use of the self-assessment.. To detect the segmentation of the disc and disc boundary the circular Hough transforms has been used to determine the accuracy of segmentation. It has the high computational efficiency. A slight oval shape is found in the disc with a vertical diameter 7%-10% in which horizontal diameter is longer than it is showed by the clinical studies. The air puff test IOP measurement has better accuracy than the proposed method and the calculation of the Cup to Disc ratio (CDR) is by the proportion of the cup diameter to disc diameters. Thus in the method proposed the accuracy of the Glaucoma detection is similar to the manual measurement. Some more techinques and tests has been adopted make the proposed method more efficient and accurate.

Keywords: Glaucoma disease; CDR; Superpixel, optic nerve,retinal funds;

1. Introduction

Blindness is the common problem in the modern world due to glaucoma, because of this problem it is to be predicted that with in the year of 2020, 79 million population of the world would be afflicted by glaucoma and its basic concepts are reviewed[1to20] . The optic nerve degenerates the glaucoma characterize and it leads to changes in structural of optic nerve [1]. The optic nerve referred to optic disk due to these structural changes the visual functional will be loss. If we detect glaucoma at early stages we can predict the vision loss. During early stages, if we give some essential treatment the visual damage can be prevent[2].The ganglion cell exit from the eye in the location of optic disk with the help of nerve of the optic the photo receptors visual information is send to brain. Optic disk has two distinct zones. One is central bright zone and another is peripheral region. The bright zone of central is also called as cup and peripheral region is also called as Neuro-retinal rim[3]. In cup region, the nerve fibers are bending and if any loss in the nerve of the optic fibers leads to change in optic disk structural appearance. The thinning of Neuro-retinal rim in the cup region is called cupping. It is most important indicator to progress the glaucoma[4]. Through ophthalmoscope the patient loss of visual field and intra-ocular pressure tests will be taken to detect glaucoma. To identity the glaucoma stages the different parameters are recorded and estimated. The Optical Coherence Tomography and Heidelberg Retina Tomo are advance modalities to estimate the, cup diameter, diameter and area of OD, mean cup depth, rim area etc. The 3-D detail information is in pseudo-color image or colorless form provided by Optical Coherence Tomography and Heidelberg Retina Tomo technique. The experts manually marked disk parameters to extract 3-D image disk boundaries [5, 6]. To generate super pixels, each approach has advantages and disadvantages for a particular application it may be suited. If image boundaries are paramount, the graph method is an ideal which produces a regular lattice and that method is better choice to constitute.

1) Super pixels must adhere to complete boundaries of image.

2) If we reduce complexity of computational as preprocessing step, super pixels must fast, efficient memory and simple.

3) For segmentation, super pixels must increase their speed and the quality should be improved [7,8]. The empirical comparison performed for super pixel methods to evaluate the speed, defect on segmentation and ability to adhere the image boundaries. The qualitative reviews are provided for the super pixel methods. The existing system is not satisfactory to address the impact so the super pixel method is proposed to segmentation.

In the year of 2020 and 2010 the most people estimate the OAG and ACG. The reviews are taken to prevalence models. The population based data of age particular existing of ACG and OAG is used to build the existing models for ACG and OAG by sex, age and ethnicity. The models were combined and estimated with glaucoma projections in the UN world population in 2020 and 2010. In 2010, 60.5 million populations with ACG and OAG will be there [9]. By the year of 2020, the population will be increase to 79.6 the 74% of people have OAG. In 2010, women had 70% ACG, 55% of OAG and 59% of glaucoma.87% of ACG and 47% of glaucoma will be represented by Asians. In 2010, blindness of bilateral will affect the 3.9 million populations with ACG and 4.5 million populations with OAG. The Second cause of vision loss in the world wide is glaucoma affecting women [8, 10]. Based on image photographs of fundus automated system classification focused by J. Meier, G. Michelson, R. Bock, J. Honegger, and L. G. Nyl. The fundus photographs not depend on prior expert knowledge or structure segmentation. To detecting the glaucomatous in retina fundus a new data approach gives accuracy [11].

To provide input for most reliable glaucoma detection ,we have to study image processing. Without deleting information the discrimination between glaucomatous eyes and images of healthy, we need to reduce disease.Before subsequent classification and feature extraction, non-uniform illuminations are corrected, normalize the region interest and blood vessels painted. Features selection and strategy of classification is challenging and very difficult because the level of image is computed normally[14].In fundus of retinal images to detect the OD position the new method presents by

A.Ruggeri, M. Foracchia and, E. Grisan. It based on detection of preliminary in retinal vessels. From the OD all vessels of retinal originate and path follows pattern of directional in the images.To explain the direction of retinal at given position of the image, parametric model of geometrical was proposed,In OD center the two model parameters coordinates. By annealing optimization technique, identify the model parameters, by vessel identification, centerline points of vessel data samples and vessel directions experimented.The estimated values coordinates center of the OD. To develop the systems Optic discis important for diagnosis of different ophthalmic pathologies.For segment the OD from retinal images in digital a template based method are presents by Diego Marín, Manuel Emilio Gegúndez-Arias and Arturo Aquino[16].To obtain circular optic disk boundary, edge detection and morphological techniques followed the Transform of Circular Hough requires the pixel location in the OD. Location based voting algorithm is proposed and this algorithm was evaluated on different images and results were good. In retinal screening the segmentation and efficient OD localization are important. The detection edge algorithm is often not eligible to segment the OD due to boundaries of fuzzy,inconsistent edge missing features or image contrast.Segmentation of nerve head of optic boundary at low-resolution pictures and localization algorithm presented byAndrew Hunter and James Lowell [17].OD localization achieved using template matching, segmentation by contour deformable model later uses elliptical of global model and deformable of local model with edge-strength of variable dependent stiffness.From a screening of diabetic program the algorithm was evaluated against selected images.Ten image classified as unusable and others variable quality. Algorithm of localization succeeded in usable image.These algorithms not have good performance. The nature of variable image and boundaries concentric distracter was desired rim. It might be located outside or inside of rim.Erosion with FCM is an effective OD and optic disc segmentation and dilation of deployment proposed by Noorhayati Mohammad Noor and Abdul Khalid[18].Using fundus of digital camera the glaucoma disease will be monitored.The images were stored in format of RGB it splitted in to blue, green and red channels.Green channel are most suitable to contrast the extracted channel segmented with Fuzzy c-Means. In another, vernacular removes the ophthalmologists and preprocessed dilation. The CDR calculated from the ratio of diameter of segmented disc and cup.Vernacular improved the specificity, sensitivity, accuracy of segmented result.FCM disadvantage is for noisy artifacts image based on pixel intensity distribution so intensity variations is sensitive for segmentation clustering algorithm used.Based on segmentation optic disk and optic cup regions were obtained from retinal images of monocular proposed by Joshi. To get OD segmentation the contour model used[19].Enhancing C-V model is by adding information about image at contour point. The disadvantage of this approach is not providing good quality. The measurement of cup to disc ratio proposed by Babu.The cup to disc ratio is important indicator to detect the glaucoma [19]. The OD is using edge Detection, morphological, Extraction techniques proposed by Arturo. The pixel need to locate in the OD,location based methodology voting algorithm is proposed by Leo-Sang-Ran and evaluated the image but this methodology had poor quality of visual. Applying the technology to enhance the clinical study of the glaucoma disease[20].

2.1. Problem Definition

The glaucoma is conditional term of pathology and the forwarding movement of the degeneration of optic nerve that is the major cause for losing the vision. The losses over the optic nerve are occurring because of the huge pressure on eye. The Glaucoma is being identified by IOP (Intra ocular pressure) system, appearance of optic disk (cup-to-disk) and the visual field. The CDR (cup-to -disk) ratio is generally having the characteristics of time invariant. So, CDR is one of the better techniques for identifying the Glaucoma and the progression of glaucoma.

3. Proposed System

3.1 Overview

This paper proposes the SLIC algorithm for the purpose of segmentation on the basis of optic cup and optic disk for identifying the Glaucoma symptoms. The Human eye is taken as the input where the generation of super pixel method is playing a vital role for generating the histogram, the histogram is presenting pixel value and optic cup and optic disk segmentation process is taking place for further. The CDR (cup –to-disk ratio) value is being calculated by using the optic cup and optic disk segmentation technique. The Glaucoma will be identified if the value of CDR will be smaller than threshold value 0.3. and the entire representation is displayed in”Figure.1”.

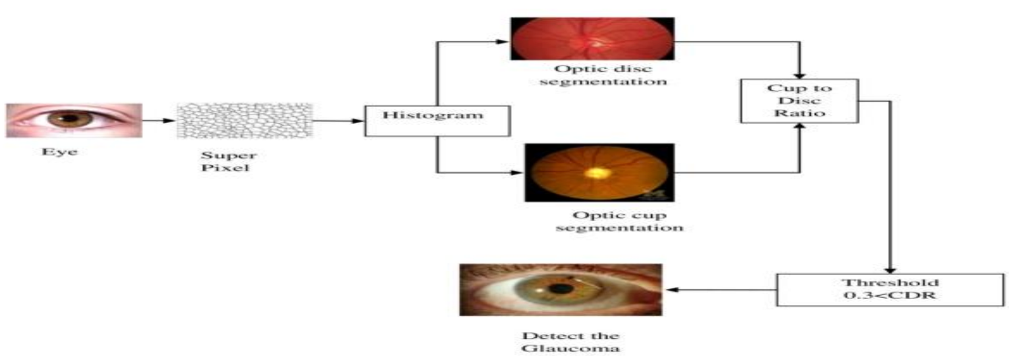

Figure.1.overall architecture.

3.2.Super Pixel Generation

This paper proposed retinal fundus of images using simple linear iterative clustering algorithm (SLIC) to aggregate purpose of pixels into super pixels. SLIC is fast, memory efficient and has excellent boundary adherence when there are difference between other pixels. Any parameter using SLIC, it is simple and easy to understand, i.e., the super pixel size is high if SLIC algorithm has more details of algorithm in this chapter. All super pixel and image using are similar compactness parameter in SLIC.

SLIC image are smooth if regions but rough-textured highly in other images. SLIC is producing super pixel both regular and highly irregular difference between in smooth region and textured region. So every image chooses correct parameter in SLIC then, high boundary recall and overcome the small number of super pixel with low segmentation error.

3.3. Optic Cup Segmentation

In 2-D images of fundus identifying the boundary of cup is a critical task without having depth information, because depth is important indicator of cup boundary. One landmark is used to determine cup region in 2-D fundus images is pallor. It describes highest color contrast in inside area of the disc

3.4.Optic Disc Segmentation

Finding a disc pixel focused by the localization is very frequent to the center. It mainly focused on application of diabetic screening. Our Proposed work concentrates on segmentation. The earlier concept disc method in our data set works well for glaucoma diabetic screening, because compared to diabetic screening some white lesions are there to confuse disc localization.

Estimation of disc boundary from segmentation is a challenging work due to blood vessel occlusions, pathological changes around disc, variable imaging conditions, etc. The deformable model technique is used in reduction of the energy function:

- Intensity of image,
- Gradient of Image, and
- Smoothness of Image Boundary.
- The set of level is being employed for estimating the disk that followed through fitting of ellipse for the boundary smoothness.

3.5. Cup to Disc Ratio

After getting cup and disk values, different features can be computed. In glaucoma screening CDR is a most important indicator. The calculated CDR is used for glaucoma screening. If CDR reaches greater than threshold, it is glaucomatous. Therefore CDR= VDD/VCD Where CDR= Cup to Disk Ratio,VDD= Optic Disk Segmentation Value and VCD= Optic Cup Segmentation Value.The CDR will be computed by optic disk Segmentation value and Optic Cup Segmentation value.

3.6. Algorithm

SLIC super pixel segmentation

Cluster centers initialization Ck = [l_k; a_k; b_k; x_k; y_k] T

[At regular grid steps S with sampling pixels

Cluster centers moved to lowest gradient position at

3 x 3 neighborhoods]

Set label l(i) = -1 for each pixel i.

Set distance d(i) = ∞ for each pixel i.

Repeat

/* Assignment */

Assigning each cluster center Ck do

Assigning each pixel i in a 2S x 2S region around Ck do

Find the distance D between Ck and i.

if D < d(i) then

set d(i) = D

set l(i) = k

end if

end for

end for

/*Update */

Find the new cluster centers.

Find the residual error E.

till E ≤ threshold.

SLIC is simple and easy to handle, the desire number of super pixel sized is equal and parameter algorithm is k by default. For color images In the CIELAB color space, a regular grid spaced S pixels apart from that the clustering procedure begins with an initialization step where k initial cluster centers Ci= [li ai xi yi]T are sampled on. To assign roughly equally sized from super pixels with S= √N/K is the grid interval. The changes to 3×3 neighborhood happen when moved towards the lowest gradient position. Then next applied clustering, for all SLIC iteratively looking for it is matching best pixel from the 2S× 2 neighborhoods around based on color and spatial proximity and then compute the new cluster center based on the found pixel. SLIC is based on color and spatial proximity and then found pixel based computes the new cluster center. Distance using the new centers and one previous is small enough until iteration continuous. Finally, post processing to applied an enforce connectivity. The location using each pixel is associated with the nearest cluster center whose search region overlaps. K-means clustering where each pixel must be compared with all cluster centers, this is the key to speeding up our algorithm because limiting the size of the search region significantly reduces the number of distance calculations, and results in a significant speed advantage over conventional. In each pixel it is possible through the introduction of a distance measure D nearest cluster center. Since the expected spatial extent of a super pixel is a region of approximate size and the search for similar pixel is done in a region around the super pixel center are S X S and 2S X 2S. Once, the nearest cluster center from associated with each pixel, an update step adjusts the cluster centers to be the mean [l a b x y]T vector of all the pixel s belonging to the cluster. They compute a residual error using L2 norm with two different location between the new cluster center location and previous cluster centre locations in E. similarly, reassigning disjoint pixel to nearby super pixels using post processing steps enforces connectivity.

4. Result and Discussion

4.1. Experimental Setup

Our proposed system performance is identified by a sequence of operation conducted in extracted Data set. The following Configuration is used to implement our proposed methods.

1) Windows 7, 2) Intel Pentium(R), 3) CPU G2020 and 4) processer speed 2.90 GHz.

4.2. CDR computation

Table.1. CDR Computation.

S.NO	NORMAL		ABNORMAL	
	CDR Computed from Actual Image	CDR Computed from Elliptical Image	CDR Computed from Actual Image	CDR Computed from Elliptical Image
1	0.3146	0.3210	0.4049	0.416
2	0.3141	0.3221	0.4040	0.4112
3	0.3147	0.3327	0.3792	0.3912
4	0.1815	0.2121	0.4639	0.4731
5	0.2736	0.2964	0.4901	0.5201
6	0.3141	0.3214	0.3741	0.3810
7	0.3251	0.3315	0.4925	0.5322
8	0.321	0.3354	0.4214	0.4314
9	0.2680	0.2816	0.450	0.4642
10	0.261	0.2898	0.4210	0.4321

The mentioned table 1 is presenting the identification of normal and abnormal Glaucoma symptoms for actual and elliptical image. The cup to disk ratio (CDR) calculation is presenting the computation value of normal and abnormal value of actual and elliptical image of eye.

4.3. Accuracy Measurement

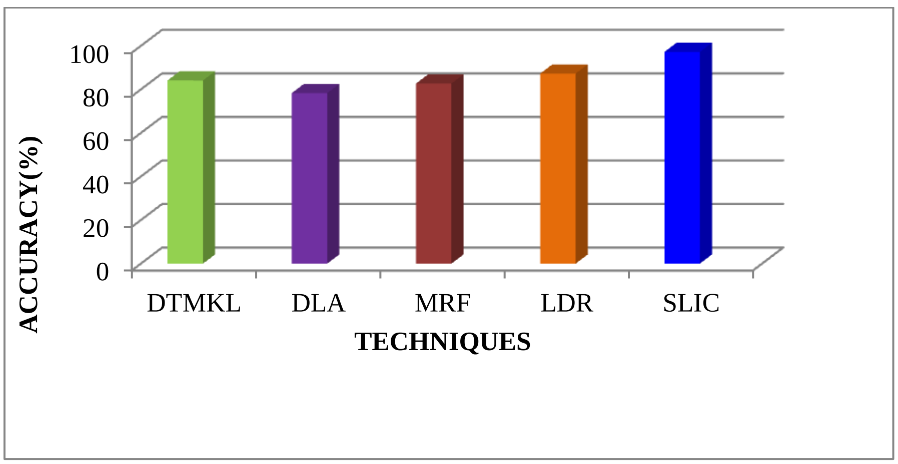

Figure.2. Accuracy Measurement.

The figure 2 is presenting the accuracy of the proposed technique SLIC (Simple Linear Iterative Clustering) which is better than other existing technique. The proposed technique is providing more accuracy over the existing issues.

4.4.Histogram Channel

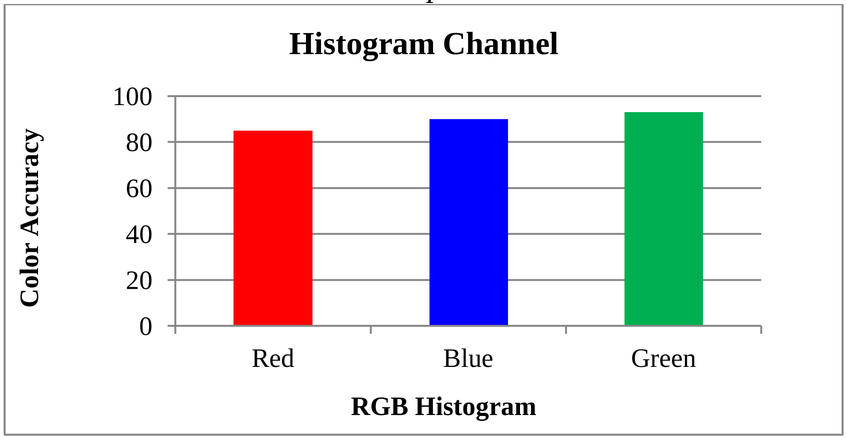

Figure.3. histogram channel.

The figure 3 is presenting the histogram channel accuracy within the proposed technique SLIC algorithm. The proposed technique is producing better color accuracy in compare to other existing techniques.

4.5. ROC Curves for Sensitivity and Specificity

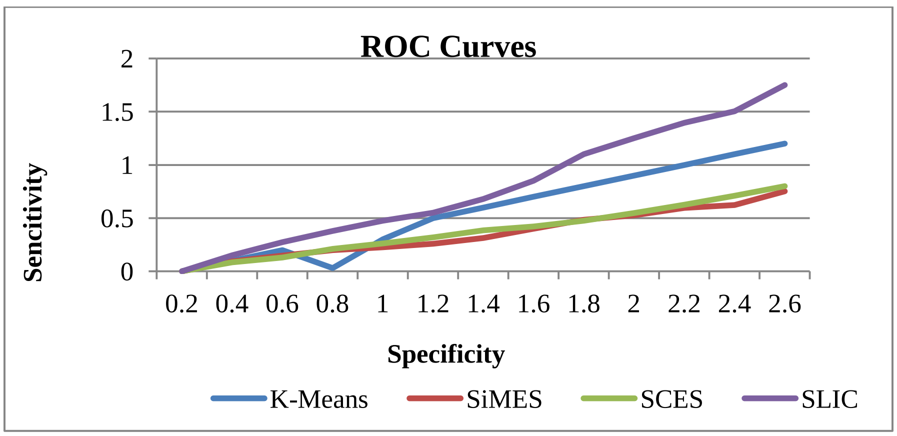

Figure.4. ROC curves for sensitivity and specificity.

The figure 4 is presenting the ROC curves for the sensitivity and specificity of the eye with proposed technique SLIC and existing techniques. The proposed technique is providing a better result in compare to other existing techniques. The sensitivity and specificity result with SLIC is better than other techniques.

5. Conclusion

This paper is presenting the SLIC technique for identification of the Glaucoma which is the main causes for the blindness. The treatment of the Glaucoma is not easy but the prevention is a main step for avoiding this diseases. The SLIC algorithm is providing a better way to identify the Glaucoma symptoms before affecting the eye. For identifying the Glaucoma, the Super Pixel, Histogram, and Disk-cup segmentation process are required. The Super Pixel is generating the image as per the required number of pixels. The super pixel image is being transformed into the segmentation process, where the image is separated by the background surface by the process of Optic disk segmentation and Optic cup segmentation. The segmentation process is generating the Cup to Disk Ratio (CDR). Using optic Cup and Disk value we can find the Cup to Disk Ratio (CDR). The CDR value is representing the Glaucoma existence in the eye. If the CDR ratio is greater than or equal to 0.3 threshold ($CDR \geq 0.3$)there is Glaucoma affected and the less than 0.3 threshold ($CDR < 0.3$) is representing that there is no Glaucoma affected in the eye.

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