A Hybrid Approach of Detection of Glaucoma with Optic Disc and Optic Cup Segmentation in Retinal Fundus Images

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Abstract

Glaucoma is an unending eye ailment which prompts vision misfortune(loss). It is a quiet theft of sight.currently manual evaluation of optic disk and cup is a standard procedure which has its own drawbacks for mass screening Early discovery of glaucoma can possibly lessen the danger of visual deficiency. Nonetheless numerous patients are ignorant of the ailment, since it advances gradually without effortlessly detectable indications. In late studies, there is no viable technique for minimal effort populace based glaucoma recognition or screening. In this work, the propose strategy is cup to disk proportion (CDR) evaluation, utilizing 2-D retinal fundus pictures. In the first place, the picture is pre-prepared by changing over the picture into HSI and applying the channel. Taken after by, the optic plate is initially divided and reproduced utilizing a novel scanty uniqueness obliged coding (SDC) approach. Considers both the difference imperative and the sparsity requirement from an arrangement of reference circle with known CDRs. In this way, the reproduction coefficients from the SDC are used to register the CDR for the testing circle.
Keywords: Canny edge detection, Circular Hough transform,CLAHE, SDC, SLIC,GLCM,LBP

I. INTRODUCTION

Glaucoma is gathering of eye sicknesses bringing on optic nerve harm. Optic nerve conveys pictures from retina,which is the particular light detecting tissue to the cerebrum so we can see.Glaucoma is a chronic eye disease which results in Sight loss permanently, as a result of survey of 80 million people will going to suffer this Glaucoma by the year 2020.Once Glaucoma came, there is no treatment to cure this disease permanently, hence early detection & giving treatment on time will reduce the amount of sight loss. The Glaucoma is called as silent theft of sight because symptoms detection of Glaucoma disease will be difficult to find & to understand and it can be slow down by proper treatment.Currently intraocular pressure (IOP) are not so good for screening of such million people who are affected by Glaucoma, and also another system were introduced that is Optic nerve head (ONH) assessment but major disadvantage of this is only trained professionals are able to do screening and it requires man power so which results in time consuming and expensive also, so to avoid this my paper proposes that on Image processing technique for early & quick detection and screening of Glaucoma disease using a method called Cup to Disk ratio (CDR) 2-D Retinal fundus images assessment. In the suggested method,the optic disc is first segmented and reconstructed using a novel sparse dissimilarity constrained coding (SDC) approach which recognizes both those divergence demand and the sparsity demand from An situated about reference discs with known CDRs.Subsequently, The fragmented optic disc What's more optic cup would that point used to figure the cup to disc proportion to glaucoma screening.the remaking coefficients from those SDC need aid used to figure the CDR to the testing disk.Those cup to disc proportion (CDR) of the shade retinal fundus Polaroid picture will be those essential distinguish with affirm Glaucoma to An provided for tolerant.Analysis is generally done by direct examination of the critical neuroretinaledge utilizing an ophthalmoscope or in view of advanced retina pictures gained by gadgets for example, the Heidelberg Retina Tomograph (HRT) [3] or the KowaNonMyd fundus camera, In this work, I utilize the methodology of colour fundus photos. The obtaining is appropriate for screening applications since fundusphotographs can be taken quick and with no weakness for patients.Glaucoma is described by a consistent harm of optic nerve fiber over a timeframe. Optic nerve fiber conveys data from photoreceptor to cerebrum. Optic plate is an area where optic nerve fiber starts and conveys data to cerebrum. Optic plate (OD) can be isolated in two distinct territories a focal splendid range called glass and an external encompassed region called neuroretinal edge.The growth of this focal brilliant zone called cup is created by the harm of this optic nerve fiber which lead to the basic changes in optic disk. Appraisal of these basic changes physically is the methodology used to recognize glaucoma.

II. PROBLEM STATEMENT

At this moment, the air-puff intraocular weight (IOP) estimation, visual field test, and optic nerve head (ONH) assessment are habitually used as a piece of glaucoma evaluation. In any case, the IOP estimation gives low precision in glaucoma distinguishing proof and a visual field examination requires outstanding rigging simply exhibit in particular recuperating offices. As needs be, they are unsuitable for screening in the people. ONH examination is all the all the more promising for glaucoma screening. It ought to be conceivable by an arranged.capable. Not with standing, manual examination is subjective, repetitive, and expensive. Recently, electronic figurings for ONH assessment have become much thought.

III. SYSTEM ARCHITECTURE

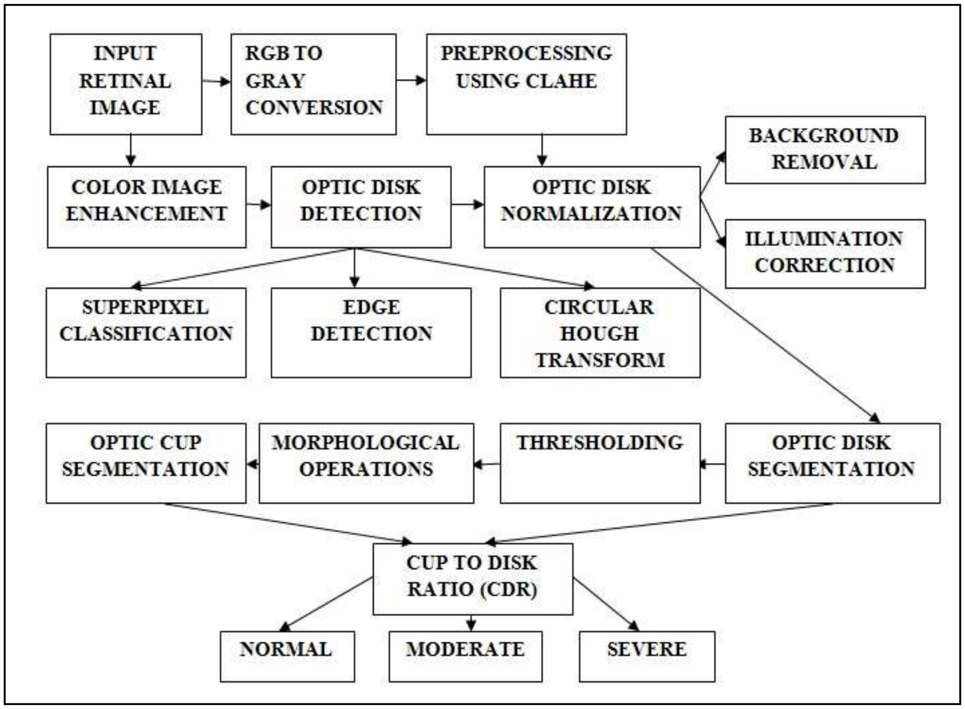

Fig. 2: proposed block diagram

In Input retina image, collecting the eye image samples which are going to be test the glaucoma disease and those images are in the form of red, green and blue images so those images are passed under RGB to Gray conversion methods where we can get to know the which color image is good to detect the Glaucoma, so here Green image will show the clarity and I used Green color MRI images as reference.After that preprocessing is done by using CLAHE algorithm. Now color enhancement and optic disc detection and optic disc normalization is done in this optic disc normalization if eye image contains any noise such distortion will removed here and any biological illumination appears will going to clear by illumination correction. In optic disc detection superpixel classification, edge detection of retinal images using Canny Edge Detection algorithm and also circular hough transform will done and after detection of edges then optic cup and disk segmentation is performed by using SLIC technique, finding thresholding and performing some morphological operations it is possible to find my Aim that is calculating cup to disc ratio hence after computing the input images, able to find, if the input image is normal displays as NORMAL if moderate affects shows as MODERATE glaucoma, it can be cure by taking treatment if the image is with severe affected glaucoma then shows SEVERE glaucoma present, it can’t able to cure at this time of evaluation.

IV. DISC LOCALIZATION, SEGMENTATIONAND NORMALIZATION

With a specific end goal to figure the CDR utilizing the proposed SDC, it is essential to find and fragment the disk. The disc confinement concentrates on finding an inexact area of the disc, exceptionally frequently the disc focus. It has been broadly concentrated on for applications in diabetic screening. The disc restriction is frequently accomplished in view of splendor anatomical structures among the disc, macula, and retinal BVs or the relative areas of these anatomical structures. In this paper, the disc is found utilizing our before shine based technique in which functions admirably in our datasets for glaucoma screening as there are few white sores to confound disc confinement as contrasted with diabetic screening. The division assesses the disc limit, which is a testing assignment due toBVocclusions, obsessive changes around disc, and variable imaging conditions. Numerous calculations have been proposed for disc division, for example, layout based methodologies deformable model-based methodologies [6], [30] and arrangement based methodologies. In this paper, section of the disc utilizing the condition of-theart self-evaluated disc segmentation technique, which is a blend of three methodologies. It has been demonstrated that the selfassessed approach accomplishes more exact disc segmenttion than the individual techniques.

A. Disc Normalization

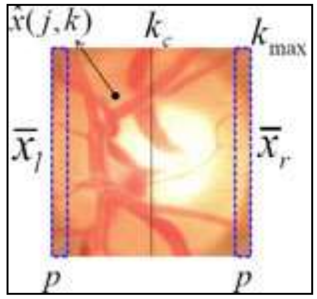

Fig. 3: Illustration of unbalance correction: A linear mapping based on the average intensities on the left and right side.

There are numerous decisions for the circle representation. Prior experience [5], [9], [17] demonstrates that the green channel of the retinal shading picture is the most reasonable one for CDR calculation. Along these lines, we utilize this divert in the paper. All disc pictures from right eyes are flipped on a level plane to maintain a strategic distance from the distinction between the left and right eyes. The mean power is additionally expelled to dodge the distinction because of various brightenings in distinctive disk pictures. Other than that, we additionally lead BV expulsion what's more, inside circle uneven brightening adjustment. 1) BV Removal: TheBVswithin the disc change to a great extent among diverse people. The disc recreation and the divergence calculation between two disc pictures are extraordinarily influenced by them. Along these lines, it is vital to expel the BVs. Numerous robotized vessel location strategies [33], [34] reported in the writing can be utilized. In this application, we thought that it was pointless to utilize extremely mind boggling and tedious vessel division to get exact BVs for the disc uniqueness calculation and later the disc reproduction. Rather, a rough segmentationof BV is adequate for the target of figuring the disc disparity. In this paper, we utilize a morphological shutting process with an exactly chose structure component size of 5 to evaluate the BV

$$\mathrm{BV}(j,k) = \begin{cases} 1, & \texttt{If } |x(j,k) - \tilde{x}(j,k)| > T \\ 0, & \texttt{otherwise} \end{cases} \qquad (1)$$

where˜*x* = morph(*x*) denotes the image after applying a morphological closing process on *x*. *x* is obtained by replacing the vessel pixels in *x* with the pixelsin ˜*x*, i.e.,

$$\hat{x}(j,k) = \begin{cases} \tilde{x}(j,k), & \texttt{If } \mathrm{BV}(j,k) = 1 \\ x(j,k), & \texttt{Otherwise.} \end{cases} \qquad (2)$$

As shown in Fig. 2, we first compute the average intensity ¯*xl*and¯*xr*from the first and last *p* columns of the disc ˆ*x*. Then, thebalance corrected disc *xb*is computed as

$$x_b(j,k) = \frac{(k - k_c)}{k_{\max} - p}(\bar{x}_l - \bar{x}_r) + \hat{x}(j,k) \qquad (3)$$

where*kc*is the center column of the disc, and *k*maxis themaximum number of columns. In this paper, we set *p*as 10%of *k*max, i.e., *p* = 5 for our disc resized to be 50 × 50. The performance of the method is not sensitive to the value of *p*.

In this area, we present the proposed save dissimilarityconstrained coding calculation. Mean an arrangement of n reference circle pictures X = [x1, . . . ,xn] and the relating CDRs as r = [r1, r2, . . . , rn]T , i = 1, 2, . . . , n, xi means the ith equalization adjusted plate processed previously. Propelled from the sparse dissimilarity constrained algorithm[19], we need to process a direct reproduction coefficient w = [w1, . . . , wn]T for another testing disc image y while minimizing the recreation mistake $\|y - Xw\|^2$. From our experience, a couple reference plate pictures that are nearest to y are adequate to assess the CDR for y while an excessive number of reference pictures frequently prompt a predisposition particularly when the reference pictures don't have uniform CDR appropriation. In this way, we need to restrain the quantity of reference pictures utilized, i.e., we need to minimize the nonzeros components in w, or $\|w\|_0$. Since 0 - standard is a NP-difficult issue, the 1-standard $\|w\|_1$ is utilized. Moreover, as the remaking is more precise from pictures more like the test plate, we include the contrast between the reference and test circle pictures as a regularization term in the goal capacity to punish the utilization of references. Meaning the distinction amongst y and the reference plates in X as the vector d = [d1,dn]T , we need to minimize the general distinction term communicated as w $\|d \odot w\|$, where di speaks to the distinction.
pixels(*j*, *k*) with *BV* (*j*, *k*) = 1. It can be seen that

$$\vec{v} = (Q^T Q)^{-1} Q^T \vec{x}.$$

It is critical to register a divergence score between two plates which mirrors their CDR contrast. As specified, the beforehand utilized Gaussian separation [19] frequently experiences clamor, flawed vessel expulsion, and so on. Thusly, it confronts some difficulties to speak to the actualCDRdifference between two plates. Frequently, we discovered two plates with comparable CDRs have a Gaussian remove considerably bigger than two plates with critical diverse CDRs. Along these lines, Gaussian separation is not a decent decision. Truth be told, this is additionally the reason that a k-closest neighbor (kNN) approach works inadequately for this undertaking. In this paper, we watch that the general power change inside the circle is exceptionally related with the CDR esteem. Inspired from this, we propose to apply surface fitting inside the plate picture to figure the divergencedemonstrates a case of a plate picture plotted in 3-D and its best-fitted surface. Albeit higher request polynomials can be registered, a second-arrange 2-D polynomial surface S(j, k) is adequate to catch the general power change. It is characterized by v = [a, b, c, e, g]T∈ R5

S(*j*, *k*) = *aj*2 + *bj*+ *ck*2 + *ek*+ *g* = (_*q*)*T* ·_*v*

where_*q* = [*j*2, *j*, *k*2, *k*, 1]*T* and *T* denotes the transpose. This can be expressed in matrix form as _*s* = *Q*_*v*(5)where_*s* contains the coefficients *S*(*j*, *k*) strung out into a column vector, and the matrix *Q* contains the coefficients of _*q* as specified in (4).

B. Formulation of SDC

Combining the dissimilarity term $\|d \odot w\|^2$ and the sparsity term _*w*_1 with the data term $\|y - Xw\|^2$, the objective function of the proposed SDC method is then given by

$$\underset{w}{\operatorname{argmin}} \|y - Xw\|^2 + \lambda_1 \cdot \|d \odot w\|^2 + \lambda_2 \cdot \|w\|_1 \quad (9)$$

where$\lambda 1$ and $\lambda 2$ are parameters controlling the weights of the two regularization items. Rewriting the second item and merging it with the first item in (9), we get

$$\begin{aligned} & \underset{w}{\operatorname{argmin}} \left(\|y - Xw\|^2 + \lambda_1 \cdot \|d \odot w\|^2 + \lambda_2 \cdot \|w\|_1\right) \\ = & \underset{w}{\operatorname{argmin}} \left(\|y - Xw\|^2 + \lambda_1 \cdot \|Dw\|^2 + \lambda_2 \cdot \|w\|_1\right) \\ = & \underset{w}{\operatorname{argmin}} \left(\left\| \begin{bmatrix} y \\ \mathbf{0} \end{bmatrix} - \begin{bmatrix} X \\ \sqrt{\lambda_1} D \end{bmatrix} w \right\|^2 + \lambda_2 \cdot \|w\|_1 \right) \\ = & \underset{w}{\operatorname{argmin}} \left(\|\hat{y} - \hat{X} w\|^2 + \lambda_2 \cdot \|w\|_1 \right) \quad (10) \end{aligned}$$

where*D* = diag(*d*) denotes a diagonal matrix with main diagonal element *D*(*i*, *i*) = *di* , *i* = 1, . . . , *n*, 0 is a vector of 0s with length *n*

$$, \hat{y} = \begin{bmatrix} y \\ \mathbf{0} \end{bmatrix} \text{ and } \hat{X} = \begin{bmatrix} X \\ \sqrt{\lambda_1} D \end{bmatrix}.$$

(11)

C. CDR Assessment

After solving (10), we obtain *w*. Then, the ratio ˆ*r* is computed as

$$\hat{r} = \frac{1}{\mathbf{1}_w^T w} r^T w \quad (12)$$

Where 1*w* is a vector of 1s with length equals to the size of *w*. In this paper, manual CDRs from the reference images are used to form *r*.

V. RESULTS

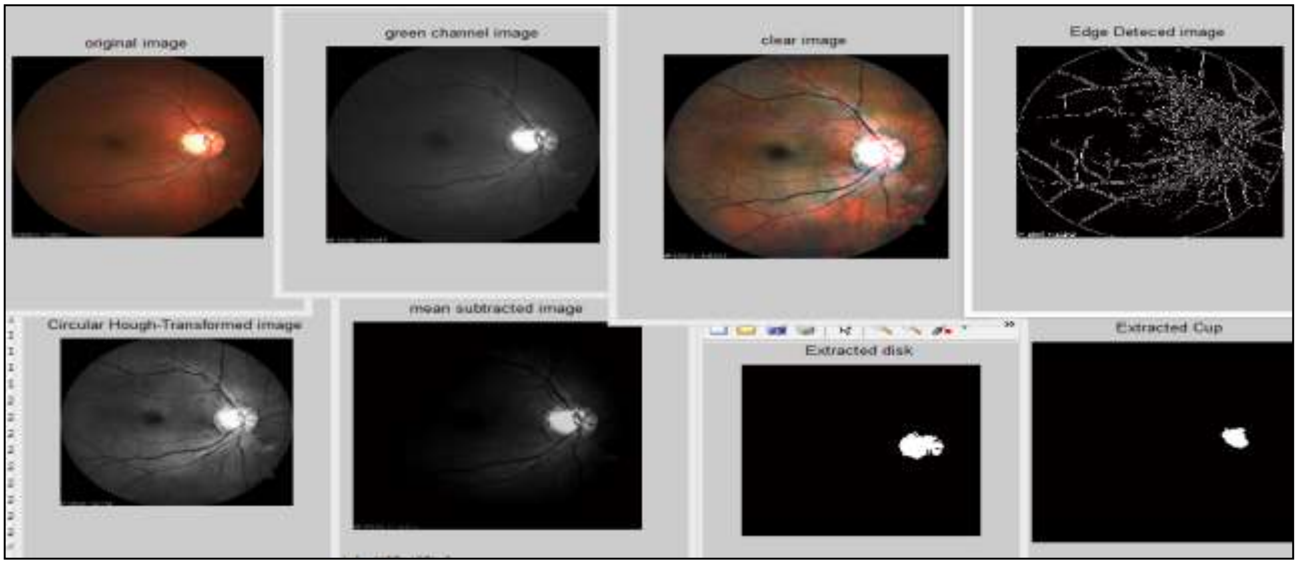

Fig. 4: normal glaucoma (i.e less than 0.4)

Fig. 5: moderate glaucoma (i.e between 0.4 to 0.5)

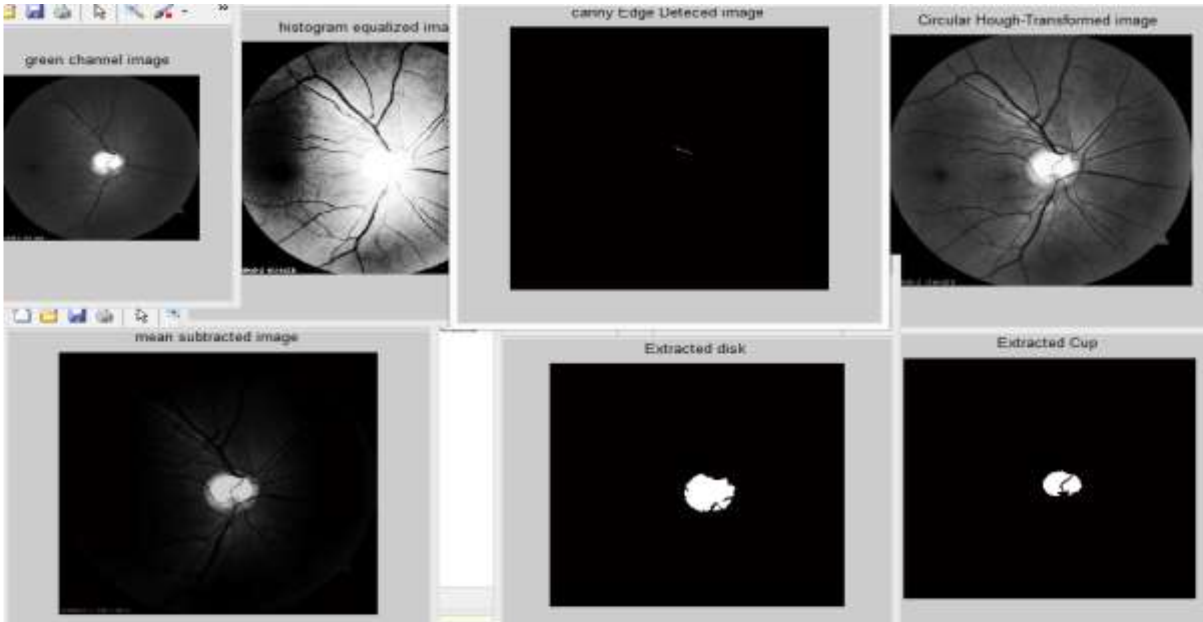

Fig. 6: severe glaucoma (i.e => 0.5)

VI. Conclusion

This paper focuses on computing the CDR from the disc. Motivated from the observation that similar discs often have very similar CDRs and the fact that many discs do not have obvious boundary between neuroretinal rim and the optic cup, we propose a sparse dissimilarity constrained coding (SDC) to estimate the CDR for a new disc image.The main contributions of this paper include 1) a novel SDC method for CDR assessment which considers both dissimilarity constraint and sparse constraint; 2) a new method to compute the dissimilarity between two disc images; 3) the results show that the proposed method achieves much more accurate CDR assessment and better glaucoma screening performance than the state-of-the-art methods.this method computes an optimal sparse linear reconstruction of the input disc from the most similar reference discs to estimate the CDR. This makes the algorithms more robust to the cases where the contrast between optic cup and rim is low.

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