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Identification of Glaucoma using Structural Modifications of Retina Images with AM Segmentation Method

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Abstract: ***Glaucoma is the second driving reason for blindness after waterfalls and its identification is basic to anticipate visual harm. Glaucoma is the third driving reason for blindness in India. The structure composed, will have the capacity to help in early discovery and conclusion of glaucoma utilizing AM segmentation and Cup to Disk Ratio (CDR) are used for the accurately detected of Glaucoma. Optic disk and optic cup diameter is measured by region props technique. Drive database is used for analyzing the proposed work. Structural parameters are measure to check the structural variation with the help of bench mark image. Report said, due to glaucoma, its structure get varies. Hence, helping ophthalmologist in prior location of glaucoma which will help the general public thus to fight the quiet enemy of vision.***

Keywords : ***retina, segmentation, CDR, Glaucoma.***

I. INTRODUCTION

Glaucoma is the second disease cause blindness in the world. Open angle glaucoma and angle closure glaucoma are the two common ways of glaucoma. Glaucoma type and the degree of closure are the factors used in glaucoma diagnosis. Iris surface is located to determine the focal region and focal edges. Automatic method for optic CDR (cup-to-disc ratio) is a significant index of Glaucoma fortitude. An appraisal degree is anticipated to measure the eccentricity between division results and the best quality level of an ONH picture recommends in RIM-ONE [2].

Glaucoma, its writes, clinical methods, and it's noteworthy of retinal highlights are displayed in [3]. Journalistlimited the natural extraction strategies on highlights containing Optic Cup to Disk Ratio (CDR), Retinal Nerve Fiber Layer (RNFL), Parapapillary Atrophy (PPA), Neuro retinal Rim Notching, Vasculature Shift, and so on. Super pixel grouping is connected for screening glaucoma by division plate and container in retinal pictures. He enhanced the division utilizing quiet change and said a constraint to such an extent that the prepared classifier is somewhat ruled by glasses with medium sizes and it is understood by the three arrangements to such an extent that to gather more examples with little and to utilize huge mugs for preparing, to receive various part, to employ the vessel twists to redress the predisposition in current container division. [4].

Untimely treatment are fundamental for influenced patients to lessen the rate of loss of sight. In [5] the creator examined that two-arrange screening i.e. PC upheld tele medicinal arranging is trailed by tele therapeutic ophthalmological analysis is indispensable. Authorobserved that age and family history are two imperative hazard elements of glaucoma. Glaucoma suspect (mellow harm of optic nerve), and influential Glaucoma (serious harm of optic nerve) is assessed with the utilization of ELGPS (East London glaucoma prediction score) electronic vulnerability adding machine is clarified in [6].Age, ethnicity/race, patient's statistic information, family, history of eye injury, visual sharpness (VA), myopia, pseudo-peeling, Intra visual weight are the basic hazard components of glaucoma.

Angle strategy is connected to fragment the container for distinguishing glass to-circle (CDR) which is a basic ownership for recognizing the ailment [7]. Container recognition is finished with the utilization of sliding windows and relapse based approach [8] instead of division and it is confines the optic glass for recognizing glaucoma. Low-rank representation(LRR) based unsupervised division enhances the exactness which in their versatile approach yields a shut frame answer for detecting the syndrome[9].For distinguishing unique highlights MRMR (minimum Redundancy Maximum Relevance)[10]scheme is utilized and illustrates what verifiable highlights the classifier uses and how the framework positions the significance of the highlights in glaucoma prediction. Computer aided design(CAD) show is raised for programmed automatic finding. Deliberate survey on CAD of visual infections and its strategies, for example, clinical, hereditary and imaging is clarified [11].

Optic Nerve Head is a stunning curved locale with a detectable container like zone called Optic Cup limited by whatever is left of the territory of Optic Disk. Optic Cup to Disk Ratio (CDR) is a basic amount for the decision of Glaucoma. [12].Perimeter is a critical component for distinguishing Glaucoma. Standard automated perimeter (SAP) and frequency doubling perimeter (FDP) approaches are utilized to determine the estimation blunder happening in glaucoma patients among the examination [13]. Audit on glaucoma, its new patterns, hazard elements to determination glaucoma, based on retinal nerve fiber analysis and retinal ganglion cell is provided in[14].

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Optical coherence tomography (OCT), DARC (Detection of Apoptotic Retinal Cells), IOP telemetry are the latest methods to detect the glaucoma at the earliest stage[15].

Review article about the daily clinical practices and algorithms developed for preoperative and postoperative periods of surgeries [16]. In [17] author examined the aggregate effects of these High intraocular pressure(IOP) and large vertical cup-to- disc ratio (VCDR) allied deviations on glaucoma. Due to RNFL thickness, structural change is occurring and it is one of the risk factor for glaucoma. OCT (Optical Coherence tomography) to assess tissue thickness of the retinal nerve fiber layer (RNFL) is demonstrated [18].ONH segmentation of retinal images is help for glaucoma diagnosis [19]. Geometrical features are identified with the use of the cup and the machine learning classifier is applied to detect glaucoma [20]. Diagnosis of glaucoma [21] is done with the use of optic nerve head using scanning-laser-tomography. Optic nerve head segmentation and its validation is explained [22]. Detection of glaucoma in iris and performance analysis is presented in proposed method. Glaucoma detection method is explained in methodology section[23]. Results and performance analysis reports are listed in result section. Conclusion is given in the last section.

II. LITERATURE SURVEY

Retinal fundus pictures are generally used to distinguish glaucoma in prior stage. Numerous analysts have proposed calculations and programmed strategies to characterize the beginning time of glaucoma. At first, pre-preparing is need to improve the picture quality which smothers undesirable bends for further handling. In [1] [5][15], pre-handling procedure is connected with low-pass channel and histogram balance, at that point Anisotropic Diffusion Filtering [7] is utilized for lessening the dot of the picture and upgrade the complexity of the edges. Anyway these strategies obscure some significant highlights in pictures, which corrupt the presentation in determination. After fulfillment of pre-handling, Optic circle division is prepared with snake based form refinement [11]. It depends on snake development for considering separation between OD focus and OD width by utilizing format coordinating. This technique does not consider the OD size and its shape, so exactness is low. To beat this issue layout coordinating [16] was utilized to roughly find the optic circle focus with the assistance of force data in HIS shading space.

At that point, shape earlier term, separation guideline term and edge-based term is intended to recognize the limit of OD. Be that as it may, this strategy endures because of the vessel edges present in and around the OD area. To deal with this, Isotropic Undecimated Wavelet Transform (IUWT) [1] and edge area refinement are proposed for fragmenting the OD with numerous highlights. It is concealing the veins for encourage the division of various pictures. Notwithstanding, this procedure was viably handled with limit districts. Shape relapse technique [6] is handled with OD shapes by utilizing inclination based relapse trees, which is utilized to become familiar with each course in fleeting and nasal region over OD. At that point, PCA is performed on the covariance network of the standardized preparing shapes. Nonetheless, covariance network is hard to tackle precisely and it is additionally tedious.

Partition of OC from OD is significant for dissecting CDR precisely with no appropriate refinement. Creators of paper [2] focused on raised body, which concentrate the cup by utilizing green plane with organizing component of cup size. It likewise centered around most brilliant power which shows up in focus purpose of pixels in OD. It is just prepared dependent on force and not focused on the cup limit.

To beat this issue, neural retinal cup discovery [23] is utilized to improve the precision of limit estimation. Circle fitting was performed for acquired plate limit and curved body was utilized for choosing highlight focuses around neural-retina cup district. Techniques for removing highlights in fundus pictures have been clarified in [20], [21], [8] and [2]. K-Means grouping [21] was connected for highlight extraction dependent on k-centroid. Separations are estimated from their particular focuses. At that point, discover the applicable point that has a place with partner the closest centroid, which intend to limit squared mistake work. This procedure is hard to anticipate k-esteem since it doesn't function admirably with groups of various size and thickness. To address this issue, surface highlights are removed [8], for example, differentiate, homogeneity, relationship, entropy and vitality. Dim level-Co-event grid is utilized to extricate these surface highlights in various shading models. To upgrade the component extraction both surface and force based highlights [2] are chosen, which incorporates Local Binary examples (LBP), wavelet based highlights, shading minutes and auto correlograms. Highlight choice was essential to choose the subset of unique highlights. Least Redundancy Maximum Relevance (mRMR) [24] include determination procedure was proposed for choosing the pertinent highlights. It was prepared with the assistance of shared data esteems relies upon each component and its objective list of capabilities. At that point, positioning procedure is led dependent on various criteria

III. METHODOLOGY

Accurate glaucoma detection methods contains building blocks such as preprocessing, segmentation of optic disk and optic cup, CDR calculation.

3.1 Pre-processing

It is used to enrich the quality of the image. Normal retinal color image is converted into a grayscale retinal image [23].

Picture pre-handling may have emotional constructive outcomes on the nature of highlight extractionand aftereffects of picture examination. Picture pre-preparing is comparable to the numerical standardization of an informational collection, which is a typical advance in many component descriptor strategies.

Then again to influence a melodic similarity, to consider picture pre-preparing as a sound framework with a scope of controls, for example, crude sound with no volume controls; volume control with a straightforward tone handle; volume control in addition to treble, bass, and mid; or volume control in addition to a full illustrations equalizer, impacts handling, and incredible speakers in an acoustically predominant room.

3.2 Optic disk and optic cup Segmentation

Segmentation [24] plays a vital role in an iris recognition system. Exiting segmentation techniques used in retinal images are morphology approach, template matching, contour modeling, thresholding, k-means (KM) algorithm, gradient flow method. Frequently used segmentation techniques are thresholding, k-means (KM) algorithm. In addition, with anticipation maximization (AM) segmentation is considered for segment the retina image to identify the optic disk and optic cup [25]. Methodology of different segmentations are given in this section. Comparison results are shown in the result section.

3.3 Thresholding method

Based on a threshold, gray retinal image is converted to binary retinal image. Each intensity level, histogram and probabilities of retinal image are calculated. Two maximal threshold values can be computed with maximal and equal values and average threshold is calculated and applied to the retinal image [26].

3.4 K-means clustering

Dissimilar regions are easily identified with the use of clustering where similar set of regions are grouped into clusters. The K-means algorithm [27] is applied to partition a retinal image into K clusters. Initially K cluster centers are identified. Then each pixel in the retinal image is assigned to the cluster that diminishes the space between the pixel and the cluster center[28].Finally, cluster centers are again computed by averaging all of the pixels in the cluster. It is represented by the Eq. 1.

$$AVG_{PP} = \left(\sum_{jj=1}^{kk}\sum_{ii-1}^{nn} xx_{ii}^{jj} - cc_{jj}\right)^2 \qquad (1)$$

Where Euclidean distance is used as the dissimilarity measure,i and $ccjj$ represents the intensity and cluster center.

3.5 Anticipation maximization (AM) algorithm

AM assigns data points to various clusters rather than a single cluster. A probabilistic distribution is used to identify each cluster, highest probability cluster is selected [29]. Gaussian mixture model (GMM) is applied to detect the missing value and it utilizes the estimation theory. It is represented by the Eq.2.

$$EE(xx_{ii}/\emptyset) = \sum_{cc=1}^{cc} pp_{cc}\, G(xx_{ii}/QQ_{cc}) \qquad (2)$$

Where cc is the number of classes that need to be extracted from the retinal image, $QQcc$ is the input retinal image, $xxii$ is the intensity level, $\emptyset = \{ pp1, \ldots, ppcc, \mu\mu1, \ldots, \mu\mu cc, \sigma\sigma1 \ldots \sigma\sigma cc \}$is the parameter vector contains mixing proportion, mean and standard deviation of the class. Expectation and maximization are the two steps applied to the retinal image to get the convergence classification matrix, then the segmented image is obtained.

CDR Calculation

After segmentation, AM segmentation is chosen as the most accurate method. CDR calculated using following steps

- Optic cup and optic disk regions are separated based on pixel values.
- Diameter of optic disk and optic cup structure is calculated using region props method.
- Ratio between the cup and disk is calculated.
- CDR values greater than 0.6 is considered as the glaucoma.

$$CDR = \frac{\text{Vertical cup diameter}}{\text{Vertical disk diameter}}$$

4. Results and performance analysis

Glaucoma detection techniques are tested on drive database [30].Simulation and experimental values are obtained using image processing tool in MATLAB 7.1. Fig.2. shows the input images andtheir resultant images.Fig.3. shows the optic cup and optic disk image.Figure.5 shows the Optic cup and optical disk values of different retinal images.

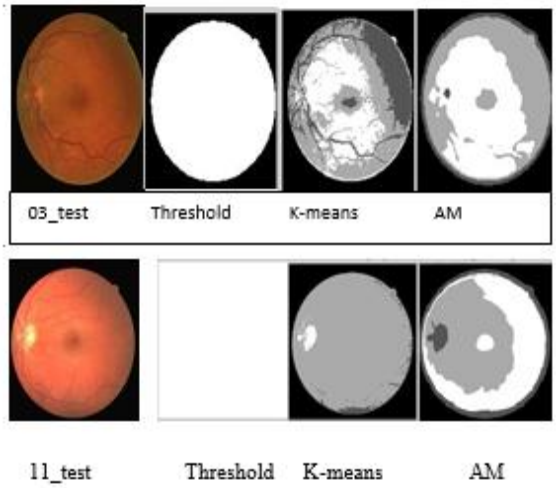

Fig. 2. Experimental simulation results (03_test, 11_test)

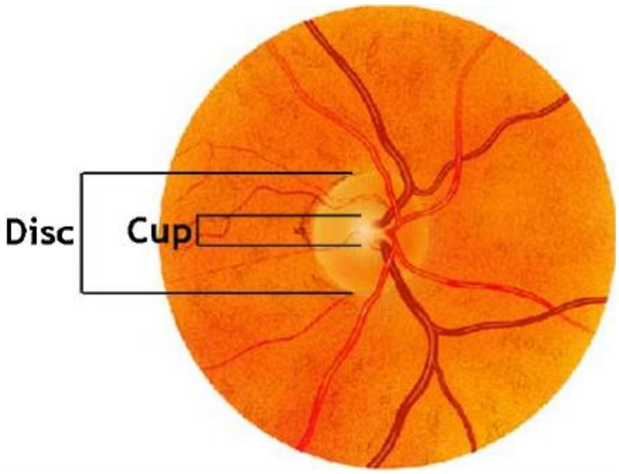

Fig.3: optic cup and optic disk image

Below the fig.4 shows the structure of the normal and disease retina. Here normal cup and nonvascular structure.

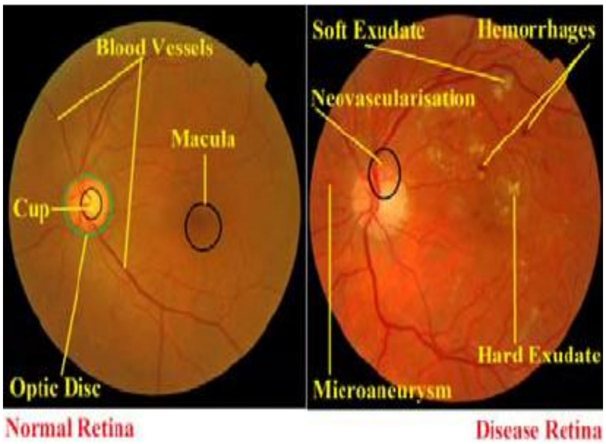

Fig.4: structure of the normal and disease retina

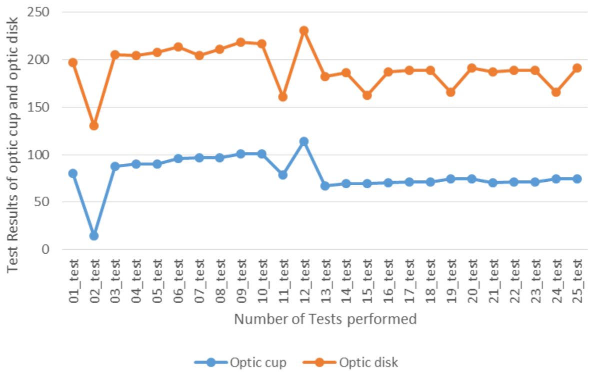

Fig.5 Optic cup and Optic disk results

From the Fig. 5, it is observed AM segmentation gives the best results in visualization, it is useful for clinician's to detect the glaucoma in the prior stage.

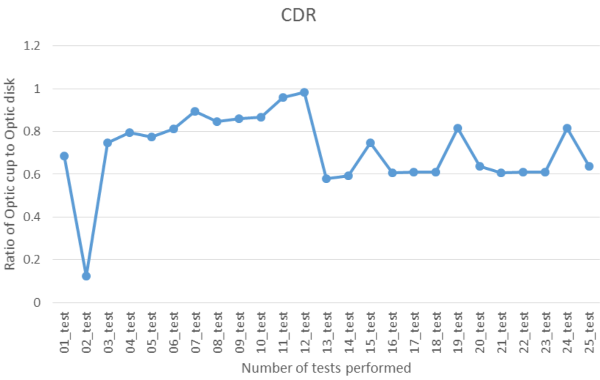

Fig.6 CDR results

Here fig.6 shows the detected glaucoma images in each test those are CDR ratio greater than 0.6 who are less than 0.6 does not having glaucoma.

Glaucoma image characteristics are verified with structural metrics. Structural Image quality [31] in which one image quality can be compared with over another image. SSIM (Structural similarity), MSSIM (Mean Structural similarity), FSIM (Feature similarity) are analyzed with the use of glaucoma image and benchmark image. Fig 4.Shows the benchmark image. Fig.7 shows the comparison values of structural metric.

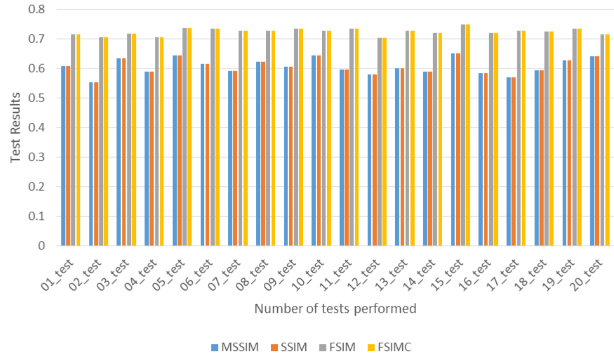

Fig.7 Structural comparisons of different retinal images

IV. CONCLUSION

Glaucoma causes extreme eye harm in the retinal and it is exceptionally hard to Diagnosis. Thresholding, k-implies (KM), desire boost (AM) division are completed and their outcomes are thought about. AM division is picked as an exact technique for division and CDR (glass to plate proportion) is ascertained to test the glaucoma. Mix check an incentive for the glaucoma recognizable proof is more prominent than six of CDR. Auxiliary measurements esteem appears, because of glaucoma iris structure get change. The proposed technique is straightforward, computationally effective and subsequently can be utilized as a supportive instrument in glaucoma screening applications. The strategy can be additionally enhanced by actualizing an OD limitation calculation which would make it completely programmed.

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