Early Detection of Glaucoma Disease using Image Processing

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Abstract

Based on the survey of various Image processing techniques, for increasing the accuracy, processing speed as well as the efficiency and reliability of the system, one will be able to use an efficient technique for the Glaucoma which is a major eye disease globally. A new and comprehensive method for an efficient detection of the disease which is a combination of techniques that exits in CDR and Blood vessel calculation with the help of SLIC superpixel classification and Hue transform for the non evasive contribution to the study and research for Glaucoma Disease is proposed. The key image handling strategies incorporate image enlistment, image combination, image segregation, highlight extraction, image improvement, morphology, design coordinating, image order, examination and factual estimation. These techniques are altogether computed using MATLAB software tool with the help of GUI to allow medical practitioners to determine whether a person is suffering from Glaucoma or not. Thus the Brightness Information of the optic cup can be directly used to determine and classify the said disease depending upon a specific and standardized threshold value.

Keywords: Blood Vessels, Cup to Disc Ratio (CDR), Fluid Pressure, Fundus Image, Glaucoma Disease, MATLAB IP, Optic Cup (OC), Optic Disc (OD), Region of Interest(ROI), Support Vector Machine (SVM)

1. Introduction

Glaucoma represents harm to the eye (optic) nerve can prompt loss of vision or even ocular deficiency1. This disease is the principle source of irreversible visual impairment on the globe2. While anybody can get glaucoma, a few individuals are at more serious danger. Glaucoma is frequently called “the sneak criminal of sight”3. Glaucoma for the most part causes no indications at a very early stage in its progress, hence it must be analyzed by regular and normal eye examinations. Intraocular weight increments above 21 mmHg when either an excess of liquid is delivered in the eye or the seepage or outpouring channels (trabecular meshwork) of the eye get to be blocked. This fluid is called Aqueous Humor4. The survey portrays the use of different image handling procedures for programmed discovery of glaucoma. The key image processing techniques to recognize eye sicknesses incorporate picture enlistment, picture combination, picture division, highlight extraction, picture upgrade, morphology, design coordinating, picture arrangement, examination and factual estimations.

In July 2012, H. Yu, E. S. Barriga, C. Agurto, S. Echegaray, M. S. Pattichis, W. Bauman, and P. Soliz, performed a work based on “Fast Localization and Segmentation of Optic Disk in Retinal Images Using Directional Matched Filtering and Level Sets”. They exhibited a quick and completely programmed OD localization & division algorithm. Initially the OD area may be recognized utilizing template matching. Likewise, the template is outlined to adjust on diverse image resolutions. Then vessel patterns on the OD are used to figure out the disc area. After that a fast, hybrid model is used for the division of the disc limit.

The primary goal of this paper is to outline individual’s eye shading picture with database of pictures compris-
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... of typical individuals and additionally, pictures of individuals experiencing glaucoma. Figure 1 shows one of the general type of fundus camera and also the obtained fundus image from it.

Performed a work on “Automated Vessel Segmentation Using Infinite Perimeter Active Contour Model with Hybrid Region Information with Application to Retinal Images”. They introduced a new limitless active shape model that employs a mixed area data of the image. For superior segmentation performance, the model employs diverse local data like combination of intensity data and local phase based enhancement plot. The local phase based enhancement plot is used for its superiority in preserving vessel edges.

The images having distinctive utilizations so as to colour varieties inside the eye is analyzed by top quality laser camera. These are called as fundus pictures. The component extraction of these fundus pictures is done utilizing MATLAB programming software. By measuring the shading pixels in the influenced domain the perception demonstrates that the individual is experiencing Glaucoma or not. To tell whether the individual is experiencing Glaucoma, an examination is made utilizing the image of a normal individual which is kept as reference and afterwards contrasted and then clinical perceptions of the individual's image is made. Further if the outcome is sure (individual is influenced with Glaucoma) then likewise check is performed for the two principle sorts of Glaucoma. The goal of this work is to assess the execution of existing techniques that identifies Glaucoma utilizing Fundus Imaging of the eye and to add to a strategy taking into account the measurable investigation of the overview to acquire expanded exactness and velocity of the framework to be created.

In June 2013, Cheng, Liu, Xu, Yin, Wong, Tan performed a work, “Superpixel Classification Based Optic Disc and Optic Cup Segmentation for Glaucoma Screening”.

This work tags the optic disc and cup division utilizing superpixel order for glaucoma identification. In OD division, histograms and focal point facts are used to arrange each superpixel as disc or non-disc. In OC segmentation alongside those above specified methods, local data will be likewise utilized to support and boost the execution process. Those fragmented optic disc and cup are then used to figure out the cup to disc proportion for glaucoma screening.

In November 2014, Salazar-Gonzalez, Kaba, Li, and Liu performed a work on “Segmentation of the Blood Vessels and Optic Disk in Retinal Images”. They introduced blood vessels and optic disc division on retinal images by coordination the component for flux, MRF image rebuild and compensation variable under the graph chart technique. The methodology likewise includes difference enhancement, versatile histogram equalization, binary opening and distance transform for pre-processing of those DRIVE and STARE fundus image database.

2. Proposed System and Methodology

Different distinctive techniques are utilized for identification of Glaucoma infection. Equivocal methods like Tonometry, Pachymetry, Gonioscopy, Ophthalmoscopy, Visual field testing and Optic Nerve Tomography are utilized. Additionally, tedious methods like different picture handling strategies assumes an essential part in ahead of schedule location of Glaucoma. The proposed framework basically comprises of three unique stages. They are Region of Interest (ROI) Extraction, Characteristics extraction and classification and arrangement stage. The blood veins and arteries and the optic disc and cup area are recognized by utilizing neighborhood entropy thresholding approach.

Diverse image handling methods utilized as a part of automated early analysis and investigation of different eye disease are Quality Improvement, Enrollment, Fusion, Segregation, Characteristics extraction, Pattern coordinating, Classification, Morphology, Factual estimations and Analysis. The proposed methodology is discussed in more detail below and can be visualized with the help of Figure 2.

2.1 Image Acquisition

The retinal image will be acquired using a fundus camera placed in front and close to the patients face such that...
an clear fundus(retinal) image is obtained. This fundus image will be used for extracting the necessary features required by the employed terminologies with the help of Matlab Software.

2.2 Pre-processing

Preprocessing is discussed in more detail with the help of Figure 3, it incorporates the elimination of unwanted signals or useless data from the crude image. It also includes uplifting the image quality, filtering and relic elimination. The ROI is extracted from the fundus image with the help of colour channel separation in Matlab software.

2.3 Feature Selection and Extraction

2.3.1 For CDR Calculation

The required components for the CDR calculations are isolated from the ROI. The component incorporates range of optic disc and optic cup. This area of the OC and OD are measured with the help of contrast information of the fundus picture using superpixel classification technique between the OD and OC. The superpixel classification uses an essential direct iterative clustering algorithm to add up to neighbouring pixels into superpixels in retinal fundus images. It is fast, memory efficient and has splendid boundary sensitivity. The centers are at first moved towards the most insignificant edge position. The algorithm iteratively chases down its best coordinating pixel from the area in view of shading and spatial closeness and then figure the new group cluster point based on the discovered pixel. The cycle repeats until the separation between the new centers and past ones is sufficiently little. Since colour will be a standout amongst the primary contrasts for the disc and non-disc area, colour histogram from superpixels is gained. Histogram adjustment is connected to red, green and blue channels starting with RGB colour spaces individually. Also, Tone(Complexion) and immersion colour space would also be incorporated to structure five channel maps to enhance the contrast to a much easier analysis. The segmentation of optic disc and cup is shown in Figure 4. The histogram of each superpixel is figured from all the five channels and balanced as r, g, b and in addition the first t and i.

2.3.2 For Blood Vessel Measurement

In this framework, first the first fundus image is changed over to Gray–level scale and thereafter the image is contrast elevated. This is then followed by blood vessel image quality improvement and highlight extraction from pixel count of the readied fundus image. Green channel is acquired from the RGB image representation of the fundus image. The green channel gives the best vessel-foundation differentiation of the RGB image. Subsequently, blood containing components in the retinal vessels are best identified with a higher difference in the green channel. Figure 5 shows Feature extraction of blood vessels. (a) Green channel of the fundus image. (b) Vessel representation from the green channel. (c) Background image. (d) Contrasted image. (e) Homogenized image. (f) Blood vessel segmented image.

Fundus images with colour are sensitive to noise and light variation and lack contrast. Hence to obtain an enhanced image so that features can be extracted for the blood vessels, these colour fundus images are converted to green channel and relevant and desired feature for blood vessels are extracted.

Gaussian filters are used to remove central light reflex and noise. The Green channel images are then used for

![Figure 2. Block diagram of proposed system.](image)

![Figure 3. Preprocessing of the fundus images.](image)

![Figure 4. Segmentation of OD and OC.](image)
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Table 1. Classification rates of several classifiers on DRIVE and STARE databases with 100 Images each.

<table>
<thead>
<tr>
<th>Classifier</th>
<th>Abnormal</th>
<th>Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>KNN</td>
<td>93.3</td>
<td>80.9</td>
</tr>
<tr>
<td>BAYES</td>
<td>86.6</td>
<td>95.23</td>
</tr>
<tr>
<td>SVM</td>
<td>100</td>
<td>95.23</td>
</tr>
</tbody>
</table>

Table 2. Average classification Accuracy of several classifiers on DRIVE and STARE Databases with 100 Images each.

<table>
<thead>
<tr>
<th>Classifier</th>
<th>DRIVE %</th>
<th>STARE %</th>
</tr>
</thead>
<tbody>
<tr>
<td>KNN</td>
<td>94.15</td>
<td>95.24</td>
</tr>
<tr>
<td>BAYES</td>
<td>95.29</td>
<td>94.76</td>
</tr>
<tr>
<td>SVM</td>
<td>94.27</td>
<td>95.19</td>
</tr>
</tbody>
</table>

Table 2 shows average classification accuracy of several classifiers on DRIVE and STARE Databases with 100 Images each.

3. Expected Results

Toward the finalization of the exploration work, we will acquire the optimum precision of 97% for the location of Glaucoma Disease. By watching the components of the fundus Image by the strategies for CDR and Blood vessel furthermore relying on the yield of the classifier, we will be able to distinguish Glaucoma. Subsequently, early detection of this sickness will assist us to take deterrent evaluation and estimation to predominate the infection in its initial course.

4. Conclusion

From the above talk about areas, diverse systems and strategies utilized as a part of these papers are valuable and compelling in one or the other way and the procedures included in the accompanying distinctive routines for division, highlight extraction, image upgrade, design coordinating, image characterization and image examination might fluctuate depending on the client necessity and other outer conditions also. A few strategies included in various approaches utilize complex and tedious calculations for Image handling, thus they require more time for execution so the execution is steady. In any case, the incomparable quality and productivity acquired in this method is more when contrasted with alternate
procedures. Consequently, in the proposed strategy, we actualize the systems for CDR and Blood Vessels that are ideal in nature to give us the ideal results.

5. Acknowledgement

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6. References