International Journal of Emerging Technology in Computer Science & Electronics (IJETCSE)
ISSN: 0976-1353 Volume 26 Issue 6 – OCTOBER 2019.

Glaucoma Diagnosis Based on Both Hidden Features and Domain Knowledge through Deep Learning Models

Aditya Mishra [#1] and M.S. Ajay [*2]

[#]Department of Computer Science Engg., Kalasalingam Academy of Research and Education, Tamilnadu, India
[*] Department of Computer Science Engg., Kalasalingam Academy of Research and Education, Tamilnadu, India

***Abstract*— Glaucoma is a chronic eye disease that cause to vision loss. As it cannot be heal, detecting the disease in time is important. This research proposes optic disc and optic cup segmentation using superpixel classification for glaucoma screening. It uses the 2D fundus images. In optic disc segmentation, clustering algorithms are used to segment each superpixel as disc or non-disc. For optic cup segmentation, in addition to the clustering for CNN algorithms, the gabor filter is also included into the feature space to boost the performance. The segmented optic disc and optic cup are then used to determine the cup to disc ratio for glaucoma screening. The CDR of the color retinal fundus camera image is the primary identifier to confirm Glaucoma for a given patient Healthy or Glaucoma stage.**

***Index Terms*— Deep learning, Disease diagnosis, Convolutional neutral**

I. Introduction

Glaucoma is an eye disease of the major nerve of a vision, called the optic nerve and it is often associated with elevated intraocular pressure, in which damage to optic nerve is progressive over a long period of time and leads to loss of vision. Glaucoma is a disease of the eye in which flowing pressure within the eye rises if left untreated the patient may lose vision, and even become blind. The disease generally damage both eyes, although one may have more severe signs and symptoms than the other.

Glaucoma cannot be healed, but its progression can be slowed down by treatment. Therefore, detecting glaucoma in time is critical to maintain the vision. Because glaucoma progresses with few signs or symptoms and the vision loss from glaucoma is irreversible, screening of people at high risk for the disease is vital. There are two kinds of glaucoma (i) Open-angle glaucoma: The entrances to the eye's drainage canals are clear, but a blockage develops within the canal, trapping fluid and causing an increase in pressure in the eye. Vision loss is normally slow and gradual (ii) Angle-closure glaucoma: The entrance to the canal is either too narrow or is closed completely. pressure can rise very quickly. The known tests to detect Glaucoma are Tonometry (inner eye pressure), Ophthalmoscopy (shape and color of the optic nerve) & Perimetry (complete field of vision). Glaucoma diagnosis is achieved in a fully automatic way. The first branch takes the entire image as input, and extracts features through a CNN. To get the input of the second branch, we use Faster-RCNN to obtain optic disc region. Then a CNN is used to extract local important features. For the third branch, we use fully convolutional network (FCN) model to segment disc area, cup area and PPA area, and then calculate measures.

II. EXISTING METHOLOGY

Liver cancer is one of the major causes of death in humans. Initial detection of tumors is essential for increasing the survival chances of patients. Several growth are happened in medical imaging modalities have enabled the acquisition of high-resolution CT datasets, and thus, allowing physicians to identify both small and large tumors by manual visual inspection. Owing to the numerous images in medical datasets, it is difficult to manually analyze all images, and useful diagnostic information may be overlooked. Moreover, the diagnoses are mainly based on the physician’s subjective evaluation and are dependent on the physician’s experience. Consequently, computer assisted diagnosis (CAD) and computer assisted surgery have become one of the major research subjects.

III. PROPOSED SYSTEM

We introduce a new method for detecting tumors in CT images. Our method is depend on adaptive contrast enhancement and the expectation maximization / maximization of the posterior marginal (EM/MPM) algorithm. User interaction is not needed and both large and small tumors can be accurately found. Compared with our previously reported method, the newly proposed method is also suitable for images with poor contrasts.

A. BLOCK DIAGRAM

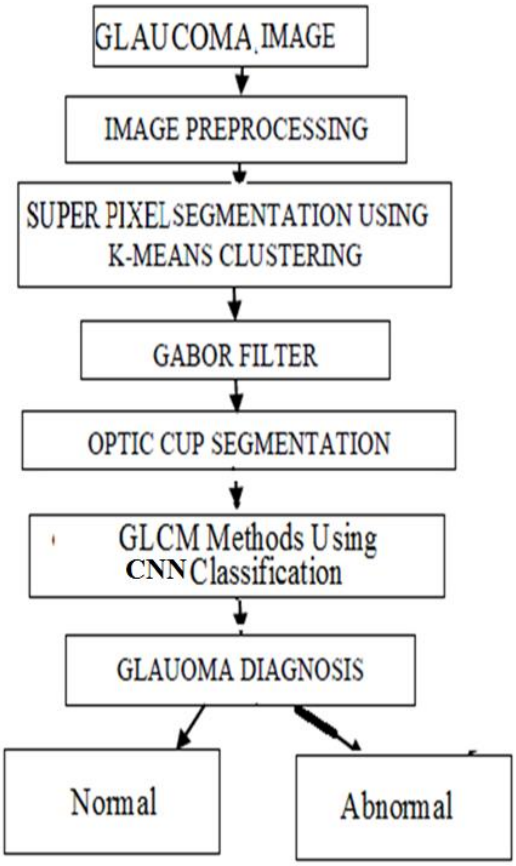

Fig.1. Block Diagram

B. METHODOLOGY

In the field of medical image processing, The detailed procedures are implemented using MATLAB. The proposed method extracts the glaucoma region accurately from the image. The experimental results indicate that the proposed method efficiently detected the glucoma region from the eye image. And then, the equation of the region in this system is effectively applied in any shape of the region.

C. Image acquisition

The data used in the experiments consist of two datasets. These datasets are composed of image patches of different cases. The first dataset was extracted from the MIAS database, containing image patches with the same size of 256*256 pixels. The second dataset was taken from the digital database for screening mammography (DDSM) database containing image patches. The diagnostic standard (benign or malignant) of all micro calcification clusters in this experiment has been given by biopsy.

D. Image enhancement

The function of mammogram enhancement is to sharpen the edges or boundaries of ROIs, or to boost the contrast between ROIs and background. The morphological top-hat transformation is used for the mammogram image enhancement. In digital image processing and mathematical morphology, top-hat transform is an operation that takes small elements and details from given images. The top-hat transform is defined as the difference between the input image and its opening by some structuring element.(D. Betal et.al, 1997).

E. Image segmentation

After performing the top-hat transformation, the aim is to extract the micro calcification cluster part. For that segmentation algorithm is applied on the image. There are two different goals for the segmentation of micro calcifications. One is to obtain the locations of cautious areas to aid radiologists for diagnose. The other is to classify the abnormalities of the breast into benign or malignant. K-means clustering is used for segmentation. In the k-means algorithm at first define the number of clusters k. Then k-cluster center are selected randomly. The distance between the each pixel to each cluster centers are estimated. The distance is of simple Euclidean function. The grouping is done by diminishing the Euclidean distance between data and the corresponding cluster centroid.

F. Feature extraction

Clinical studies have revealed that malignant micro calcifications tend to be small and densely distributed while benign micro calcifications are generally larger, and more diffusely distributed. Hence, a method is proposed a for classifying micro calcification clusters in mammograms based on their topological and shape features.

G. Optic disc segmentation

Accurate segmentations of disc and cup are necessary for CDR measurement. Many methods have been proposed for automatic CDR measurement from 2D fundus images. Fig shows major structures of the optic disc

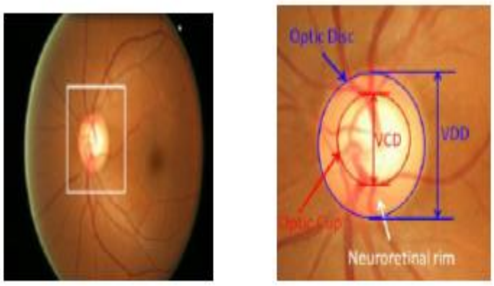

Fig.2. Major Structures of the optic disc: The region enclosed by the blue line is the optic disc; the central bright zone enclosed by the red line is the optic cup; and the region between the red and blue lines is the neuroretinal rim.

Localization and segmentation of disc are very major in many computer aided diagnosis systems, including glaucoma screening. We introduce a superpixel classification based method and combine it with the deformable model based methods.

Image segmentation is used to segmenting an image into multiple segments, as to change the representation of an image is more meaningful and easier to analyze. K-means clustering algorithm is applied for image segmentation. The classification calculates the disc boundary, which is a task due to blood vessel occlusions, pathological changes around disc, variable imaging conditions, etc. Circular Hough transform is utilized to the disc boundary. The classification technique which measures and estimates the disc boundary, which is a challenging task due to blood vessel occlusions, pathological changes around disc, variable imaging conditions, etc. Some approaches have been proposed for disc segmentation, which can be circular Hough transform is used to model the disc boundary because of its computational efficiency.

We also presentation super pixel classification based approach using histograms to improve the initialization of the disc for deformable models.

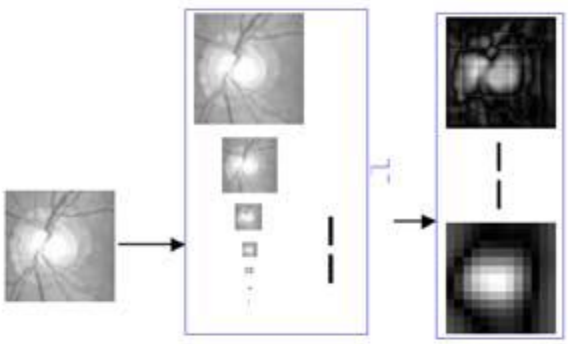

Fig.3. Segmentation

Both the template and deformable model based methods are depends on the edge characteristics. The performance of these methods very much based on the differentiation of edges from the disc and other structures, especially the PPA. 1)it looks similar to the disc;2)it screscent shape makes it from another ellipse (often stronger) to gether with the disc.

This paper utilizes the simple linear iterative clustering algorithm(SLIC) to aggregate nearby pixels into super pixels in retinal fundus images. Differentiate with other super pixel methods, SLIC is fast, memory efficient and has excellent boundary adherence. SLIC is also easy to use with only one parameter, i.e., the number of desired super pixels k. Here we permit a brief introduction of the SLIC algorithm while more details of the algorithms can be found in the SLIC. Several features such as colour, appearance, gist, location and texture can be extracted from super pixels for classification. Because colour is one of the main differences between disc and non-disc region, colour histogram from super pixels is an intuitive choice.

Inspired by the large contrast variation between images and the use of histogram equalization in biological neural networks, histogram equalization is applied to red r, green g, and blue b channels from RGB colour spaces individually to increase the contrast for easier analysis. It is important to incorporate features that reflect the difference between the PPA region and the disc region. The super pixels from the two regions often appear similar except for the texture: the PPA region contains blob-like structures while the disc region is relatively more homogeneous. The histogram of each super- pixel does not work well as the texture variation in the PPA region is often from a larger area than the super pixel. To overcome the problem, we adopt a bootstrapping strategy . The active shape model employed in is utilized to fine tune the disc boundary.

H. ROI processing

A region of interest (ROI) is a part of an image that you want to filter or perform some other operation on. An ROI by creating a binary mask, which is a binary image that is the same size as the image you want to process with pixels that define the ROI assign to 1 and all other pixels set to 0. Create ROI mask for the selected optic disc area. The roi mask choose roi image from the exact selected area of the optic disc in the gray scale image.ROI image is converted to binary image. Binarization is a process where each pixel in an image is converted into one bit and you assign the value as '1' or '0'.Morphological operations are used to remove the unwanted objects in binary image.

I. Gabor filter

In image processing, a Gabor filter a linear filter utilized for edge detection. Filters have been found to be mainly appropriate for texture representation and discrimination. In the spatial domain, a 2D Gabor filter is one of a Gaussian kernel function modulated by a sinusoidal plane wave. Gabor filters are directly associated to Gabor wavelets, since they can be designed for a number of dilations and rotations. . The filters are spired with the signal, resulting in a so called Gabor space. The Gabor space is very important in image processing applications such as optical character recognition, iris recognition and fingerprint recognition. Gabor wavelets can be modified for specific frequencies and orientations which is useful for blood vessels.

They work as low level oriented edge discriminators and also filter out the background noise of the image. Because vessels have directional pattern so 2-D Gabor wavelet is best option due to its directional selectiveness capability of detecting oriented features and fine tuning to specific frequencies.

J. Optic cup segmentation

The optic cup is the white cup, area in the center of the optic disc. the optic cup contains two strata of cells. . In cup segmentation, To calculate the cup boundary we can able use two methods. They are ROI processing and thresholding or binarization. The roi processing is done as similar as the procedure how the extracted optic disc image is obtained. The thresholding or binarization for Optic Cup segmentation Procedure is as shown below. This process will convert the given image into a thresholded or binarized image where we can simply get our Optic Cup. Binary images are gathered from color images by segmentation. Classification is the process of assigning each pixel in the source image to two or more classes.

After obtaining the disc, the minimum bounding box of the disc is used for the cup segmentation. The disc and cup boundary perceived from the segmentation methods may not represent the actual shape of the disc and cup since the boundaries can be affected by a large number of blood vessels entering the disc. Accordingly the morphological operations are employed to reshape the obtained disc and cup boundary. Then CDR is calculated by taking the ratio of the area of cup to OD.

K. Cup to disc ratio

The correlation of the vertical cup diameter into vertical disc diameter. Retina is affected to the glaucoma. After acquiring the disc and cup, various features can be computed. We come from the clinical convention to compute the CDR. As mentioned in the introduction, CDR is an important indicator for glaucoma screening computed as indicator for glaucoma screening computed as

CDR=VCD/VDD

The computed CDR is used for glaucoma screening. When CDR is higher than a threshold, it is glaucomatous, otherwise healthy.

L. Glaucoma diagnosis and screening

Screening for glaucoma is normally performed as part of a standard eye examination performed by optometrists, orthoptists, and ophthalmologists. testing for glaucoma may as well incorporate estimations of the intraocular pressure through tonometry. Modifies fit as a fiddle of the eye, foremost chamber point examination additionally gonioscopy. and examination of the optic nerve to search for any visible harm to it, or change in the glass to-disc proportion and additionally rim appearance and vascular change. A visual field test ought to be performed. The retinal nerve filament layer might be surveyed with imaging techniques such as optical intelligibility tomography, filtering laser polarimetry, or examining laser ophthalmoscopy.

IV. EXPERIMENTAL EVALUATION

We included our proposed method to five sets of glaucoma images. Information on each image.

L = 0.2157
level = 0.0945
itteration 1
itteration 2
level = 0.3569
stats = Centroid: [207.2367 208.1044]
MajorAxisLength: 476.2952
MinorAxisLength: 381.3469
stats = Contrast: [1x40 double]
Correlation: [1x40 double]
Energy: [1x40 double]
Homogeneity: [1x40 double]
Contrast = 0.2835
Correlation = 0.9282
Energy = 0.1483
Homogeneity = 0.8911
y = 1
Sensitivity = 97.9178
Specificity = 93.5895
Accuracy = 99.2464

V. CONCLUSION

This paper is implemented using GLCM Based CNN classification based optic disc and cup segmentations for glaucoma screening. This work is mainly for Glaucoma detection in patients using multimodalities including simple linear iterative clustering (SLIC) algorithm, K-Means clustering, and Gabor wavelet transformation of the color fundus camera image to obtain accurate boundary delineation. Using structural features like GLCM the ratio value exceeds 0.3 shall be recommended for further analysis of a patient to the ophthalmologist. This shall help in patients worldwide by protecting further vision deterioration through timely medical intervention. The accuracy of the proposed method is much better than the IOP measurement, abnormal visual field and previous GLCM based CNN Classification methods Glaucoma detection.

REFERENCES

[1] P. N. Schacknow, J. R. Samples, The glaucoma book: a practical, evidence-based approach to patient care, Springer Science & Business Media, 2010.

[2] N. V. M. Anand V, Mantravadi MD, Glaucoma, Primary Care: Clinics in Office Practice 42 (3) (2015) 437–449.

[3] H. A. Quigley, A. T. Broman, The number of people with glaucoma worldwide in 2010 and 2020, British journal of ophthalmology 90 (3) (2006) 262–267.

[4] J. C. Javitt, Preventing blindness in americans: the need for eyehealth education, Survey of ophthalmology 40 (1) (1995) 41–44.

[5] J. B. Jonas, W. M. Budde, S. Panda-Jonas, Ophthalmoscopic evaluation of the optic nerve head, Survey of ophthalmology 43 (4) (1999) 293–320.

[6] R. R. B. A. M. B. R. R. S. P.-J. Jost B Jonas, Tin Aung, Glaucoma, The Lancet logo 390 (2017) 2083–2093.