Available Online at www.ijcsmc.com

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320–088X

IJCSMC, Vol. 4, Issue. 5, May 2015, pg.158 – 165

RESEARCH ARTICLE

A Study on Retinal Disease Classification and Filteration Approaches

Parul[1], Neetu Sharma[2]

[1]Research Scholar, Department of Computer Science and Engineering, Ganga Institute of Technology & Management, Kablana

Email ID: parularora117@gmail.com

[2]HOD, Department of Computer Science and Engineering, Ganga Institute of Technology & Management, Kablana

Email ID: neetush75@gmail.com

Abstract:

Image Processing is having is significance for disease detection on medical images. These disease recognition and classification approaches are specific to human organ and image type. One of such disease class includes detection of retinal disease such as glaucoma detection or diabetic detection. The paper has defined a study on disease recognition approaches such as SVM, DCT, HMM and PCA approaches. Paper also defined the image processing operations applied to filter the medical image and to perform disease area segmentation.

Keyword: Glaucoma, PCA, DCT, HMM

1. INTRODUCTION

To perform the medical image processing and disease detection, a series of image processing operations are required to improve quality of acquired image and to perform the detection. These processing stages are given here under:
Enhancement: Medical images are often deteriorated by noise due to interference and other phenomena that affect the imaging processes. Image enhancement is the improvement of image quality to increase the perception of information in images for medical specialists.

Noise Suppression: Suitable noise suppressing algorithm is selected based on what type of noise presented in the image. Impulse noise (having distribution of extreme values, only isolated pixels are affected) should be removed by Mean or Median filter. Narrowband noise (a few strong frequency components form the noise) is suppressed by removing false frequency coefficients from the discrete two-dimensional spectrum and reconstructing the image from the new spectral information.

Sharpening: Enhancing the sharpness by accentuating edges may contribute to raise more visible details in an image. Laplacian, Sobel, Robert Cross are some algorithms used to extract edges and thus increase the sharpness of the image.

Contrast Enhancement: The appearance of an image depends significantly on the image contrast. There are three contrast enhancement methods: Linear contrast adjustments, nonlinear contrast adjustments (the brightness mapping is described by linear or nonlinear functions) and histogram equalization (changing pixel intensities so that the histogram is optimized with respect to even distribution).

Image Segmentation: The goal of image segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. Image Segmentation is the process of partitioning a digital image into multiple regions or sets of pixels .Actually, partitions are different objects in image which have the same texture or color. The result of image segmentation is a set of regions that collectively cover the entire image, or a set of contours extracted from the image. All of the pixels in a region are similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristics. The goal of image segmentation is to cluster pixels into salient image regions, i.e., regions corresponding to individual surfaces, objects, or natural parts of objects. Segmentation could be used for object recognition, occlusion boundary estimation within motion or stereo systems, image compression, image editing, or image database look-up. The concept of Watersheds is well known in topography. It is a morphological based method of image segmentation. Segmentation using the watershed transforms works well if you can identify, or "mark," foreground objects and background locations.

1.1 Retinal Disease Prediction

Retinal Disease detection locates and segments Retinal Disease regions from cluttered images, either obtained from video or still image. It has numerous applications in areas like surveillance and security control systems, content based image retrieval, video conferencing and intelligent human computer interface. Most of the current Retinal Disease recognition systems presume that retinal disease is readily available for processing. However, we do not typically get images with just Retinal Disease. We need a system that will segment Retinal Disease in cluttered images. With a portable system, we can sometimes ask the user to pose for the Retinal Disease identification task. In addition to creating a more cooperative target, we can interact with the system in order to improve and monitor its detection. With a portable system, detection seems easier. The task of retinal disease detection is seemingly trivial for the human brain, yet it still remains a challenging and difficult problem to enable a computer /mobile phone/PDA to do Retinal Disease detection. This is because the human Retinal Disease changes with respect to internal factors like Retinal Disease expression, beard, mustache glasses etc and it is also affected by external factors like scale, lightening conditions, and contrast between Retinal Disease, background and orientation of Retinal Disease.

Retinal Disease detection remains an open problem. Many researchers have proposed different methods addressing the problem of Retinal Disease detection. In a recent survey Retinal Disease detection technique is classified into feature based and image based. The feature based techniques use edge information, skin color, motion and symmetry measures, feature analysis, snakes, deformable templates and point distribution. Image based techniques include neural networks, linear subspace method like Eigen Retinal Disease, fisher Retinal Disease etc. The problem of Retinal Disease detection in still images is more challenging and difficult when compared to the problem of Retinal Disease detection in video since emotion information can lead to probable regions where Retinal Disease could be located.

1.2 Medical Image Processing

Medical image processing and analysis is a technique and science to detect degenerated tissue. The main advantage of medical imaging is to make diagnosis as possible as noninvasive way in the treatment planning and clinically diagnosis. There are various types of medical imaging technologies based on noninvasive approach like Computed Tomography (CT), Magnetic Resonance Imaging (MRI) and X-Ray etc.MRI is best suitable high quality medical imaging technology rather than others to collect perfect internal information of the body organ for clinical diagnosis. Medical imaging is a field in which researches develop tools to acquire, manipulate and achieve digital images that are used to provide better care for the patients. In medical science the problem as well as the data stream is three-dimensional and the effort to solve the problem is mostly combination of both human and machine.

Medical tasks can often be split into three areas:

- Data operations like filtering, noise removal, and contrast and feature enhancement
- Detection of medical conditions and events
- Qualitative analysis of the lesion or detected events.

1.3 Glaucoma Disease

Glaucoma is a progressive degeneration of retinal ganglion cells (RGC) and their axons, resulting in a distinct appearance to the optic nerve head (ONH), often called 'cupping' **.** Glaucoma leads to visual disability. This damage also leads to improper functioning of drainage system of eye leading to increased intra-occular pressure. This IOP leads to full or partial loss of vision. It also results in change in shape of optic disk leading to increased cup to disk ratio. Glaucoma is the third leading cause of blindness, yet amongst those with the disease it is relatively rare to be registered blind according to World Health Organization criteria, as central vision is often preserved until late in the disease despite disabling loss of peripheral vision and the damage to the visual field is irreversible; however, if the disease is detected at its early stage, it can be treated. If the condition is left untreated the damage to the affected visual field usually worsens and spreads until eventually complete loss of vision can occur.

2. MODEL USED

The presented work is about the detection of retinal Glaucoma disease in optical retinal images. To perform this detection a two stage approach is presented, in first stage, the extraction of ROI will be done using intelligent segmentation algorithm and in second stage, the curvature analysis approach will be used to identify the blood vessel and cup. The work is about to identify the retinal disease more accurately.

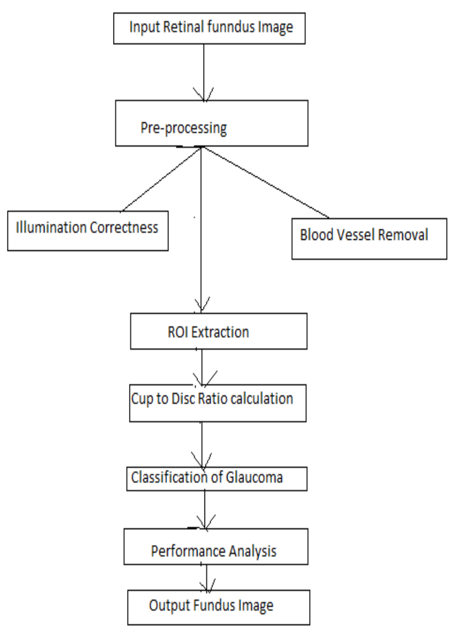

Fig1: Methodology for detection of glaucoma disease

Our methodology includes following steps:

- Data Acquisition
- Preprocessing
- Processing
- Classification or Segmentation
- Analysis of result

The preprocessing work includes the conversion of image to the normalized image as well as to extract the features from the image. The filtration process includes the adjustment of brightness, contrast, low pass, high pass filtration etc. The filtration will be done in two phases one for Iris and other for eye. Once the filtration process is done extraction of Iris and eye will be performed. Just after extraction process the feature extraction will be done. These featured images are the main input image to the system

2.1 Steps involved in the methodology

2.1.1 Segmentation

The first step for segmentation is obtaining a set of pixel values, which corresponds to the color skin in the images. The set is obtained manually, selecting a small region directly from a frame where the Retinal Disease is located.

2.1.2 Regions

After segmentation is performed, then connect all pixels to produce regular regions or blobs.

The threshold values have a large influence on the segmentation results. A small threshold value leads to a large number of small regions while with a large threshold value few large regions are calculated.

2.1.3 Detection

Finally, validate the Retinal Disease detection and position in the frame by polling. Simply, then examine all the regions, and if there is a region common to at least three colors spaces, then considered such region as the detected Retinal Disease, in the other way, if the mentioned condition is not satisfied, the region is discarded and the process is performed to the next region or the next frame.

3. Review of Literature

In Year 1992, KEITH P. THOMPSON performed a work," Therapeutic and Diagnostic Application of Lasers in Ophthalmology". The accessibility of the human eye, its transparency and the absorption properties of its internal tissues has fostered a rapid evolution of applications for lasers in ophthalmology. Lasers achieve their effects in the eye through photo thermal, photo disruptive or photochemical mechanisms. Author provided an overview of the present status of clinical and research applications for lasers in ophthalmology.

In Year 2002, Jim Beach performed a work," Spectral Reflectance Technique for Retinal Blood Oxygen Evaluation in Humans". Author present spectral reflectance curves obtained with a prism-grating-prism (PGP) spectrographic camera from structures producing hemoglobin signatures, including the retinal artery and vein, the pigmented retina and the optic disk, as well as from the macular area which is free of this signature. Oxygen-dependent changes in the hemoglobin signature are determined from vessels and tissue surround.

In Year 2006, Kevin Noronha performed a work," Enhancement of retinal fundus Image to highlight the features for detection of abnormal eyes". This paper describes the methods to detect main features of fundus images such as optic disk, fovea, and exudates and blood vessels. To determine the optic Disk and its centre Author find the brightest part of the fundus and apply Hough transform.

In Year 2007, Sangyeol Lee performed a work," Validation of Retinal Image Registration Algorithms by a Projective Imaging Distortion Model". A variety of methods for retinal image registration have been proposed, but evaluating such methods objectively is difficult due to the lack of a reference standard for the true alignment of the individual images that make up the montage. Author also presents the validation tool for any retinal image registration method by tracing back the distortion path and accessing the geometric misalignment from the coordinate system of reference standard.

In Year 2008, S. Sekhar performed a work," automated localisation of retinal optic disk using hough transform". The retinal fundus photograph is widely used in the diagnosis and treatment of various eye diseases such as diabetic retinopathy and glaucoma. The proposed method consists of two steps: in the first step, a circular region of interest is found by first isolating the brightest area in the image by means of morphological processing, and in the second step, the Hough transform is used to detect the main circular feature.

In Year 2010, Zhuo Zhang performed a work," ORIGA-light: An Online Retinal Fundus Image Database for Glaucoma Analysis and Research". In this paper Author present an online depository, ORIGA-light, which aims to share clinical ground truth retinal images with the public; provide open access for researchers to benchmark their computer-aided segmentation algorithms. Author had update the system continuously with more clinical ground-truth images. ORIGA- light is available for online access upon request.

In Year 2010, Michael D. Abràmoff performed a work," Retinal Imaging and Image Analysis". Methods for 2-D fundus imaging and techniques for 3-D optical coherence tomography (OCT) imaging are reviewed. Special attention is given to quantitative techniques for analysis of fundus photographs with a focus on clinically relevant assessment of retinal vasculature, identification of retinal lesions, assessment of optic nerve head (ONH) shape, building retinal atlases, and to automated methods for population screening for retinal diseases.

In Year 2010, Vahabi Z performed a work," The new approach to Automatic detection of Optic Disc from non-dilated retinal images". Author describes a new filtering approach in the wavelet domain for image preprocessing. Sobel edge detection, Texture Analysis, Intensity and Template matching was used to detect Optic Disc. The proposed algorithm is tested on 150 images of Messidor dataset.

In year 2009, Riries Rulaningtyas and Khusnul Ain defined a work of edge detection for Glaucoma detection detection. In this work Glaucoma diagnosis is done by doctors. For detecting Glaucoma grading always gives different conclusion between one doctor to another. For helping doctors diagnose Glaucoma grading, this research made a software with edge detections method , so it could give edge pattern of Ratinal and Glaucoma itself. Edge detection of Glaucoma in this research is the first step for Glaucoma grading research. This research found the best edge detection method for Glaucoma detecting between Robert, Prewitt, and Sobel method. From these three methods, Sobel method is suitable with case of Glaucomas detecting. Sobel method had smaller deviation standard value than two others edge detection method.

In year 2010, Ehab F. Badran, Esraa Galal Mahmoud, and Nadder Hamdy defined a new algorithm to detect the barin infection. In this paper, a computer-based method for defining infection region in the Ratinal using MRI images is presented. A classification of Ratinal into healthy Ratinal or a Ratinal having an infection is first done which is then followed by further classification into begnin or malignant infection. The algorithm incorporates steps for preprocessing, image segmentation, feature extraction and image classification using neural network techniques. Finally the infection area is specified by region of interest technique as confirmation step. A user friendly Matlab GUI program has been constructed to test the proposed algorithm

In year 2010, N. Nandha Gopal, Dr. M. Karnan defined a work on Glaucoma detection using C Means clustering algorithm. In this paper an intelligent system is designed to diagnose Glaucoma through MRI using image processing clustering algorithms such as Fuzzy C Means along with intelligent optimization tools, such as Genetic Algorithm (GA), and Particle Swarm Optimization (PSO). The detection of infection is performed in two phases: Preprocessing and Enhancement in the first phase and segmentation and classification in the second phase

In year 2011, Yanqing Xue, Shuicai Wu, Hongjian Gao, a wrok is performed on 3D visualization of Ratinal image. The paper discussed 3D visualization and analysis of Glaucoma based on magnetic resonance images. In this study, the Glaucoma was automatically identified by support vector machine (SVM), and then 3D visualization model of Glaucoma was obtained by the classic mobile cube algorithm. Furthermore, associated 3D model parameters were extracted based upon the morphologic analysis, thus providing reliable quantization information for the radiofrequency ablation operation of Glaucoma.

In year 2010, T.LOGESWARI has defined a work on Glaucoma detection using soft computing. In this paper, the proposed technique ACO hybrid with Fuzzy and Hybrid Self Organizing Hybrid with Fuzzy describe segmentation consists of two steps. In the first step, the MRI Ratinal image is Segmented using HSOM Hybrid with Fuzzy and the second step ACO Hybrid with Fuzzy method to extract the suspicious region Both techniques are compared and performance evaluation is evaluated.

In Year 2011, Zafer Yavuz performed a work," RETINAL BLOOD VESSEL SEGMENTATION USING GABOR FILTER AND TOPHAT TRANSFORM". In this paper, Author suggests a method to segment retinal blood vessels automatically. In the method, Author applies top-hat transform after Gabor filter to enhance blood vessels. Later on, the output of the transformation is converted to binary image with p-tile thresholding.

MARYAM MUBBASHAR performed a work," Automated System for Macula Detection in Digital Retinal Images". This paper presents an automated system for the localization and detection of macula in digital retinal images. In this paper, macula is first localized by making use of localized optic disc centre and enhanced blood vessels. Finally macula is detected by taking the distance from center of optic disk and thresholding, then combining it with enhanced blood vessels image to locate the darkest pixel in this region, making clusters of these pixels.

In Year 2012, K.Sangeetha performed a work," Advanced Analysis of Anatomical Structures Using Hull Based Neuro-Retinal Optic Cup Ellipse Optimization in Glaucoma Diagnosis". This research relies on the problem of detecting those abnormalities in the eye of a diabetic patient for the earlier detection of DR. Here a methodology is presented for the automatic detection of the blood vessels and abnormalities in the eye of diabetic patients using digital image processing algorithm (DIP).

In Year 2012, Nilan jan Dey performed a work," Optical Cup to Disc Ratio Measurement for Glaucoma Diagnosis Using Harris Corner". In medical study, retinal image processing plays a vital role in detecting the abnormalities of eye or ocular diseases like Glaucoma and diabetic retinopathy. In this paper, an automatic method for CDR determination using Harris Corner is proposed.

In Year 2012, R. Geetha Ramani performed a work," Automatic Prediction of Diabetic Retinopathy and Glaucoma through Retinal Image Analysis and Data Mining Techniques". In this paper, a novel computational approach for automatic disease detection is proposed that utilizes retinal image analysis and data mining techniques to accurately categorize the retinal images as Normal, Diabetic Retinopathy and Glaucoma affected.

In Year 2012, Kumar Parasuraman, has defined a work on “Automated Detection of Diseases by Nicking Quantification in Retinal Images”. This paper proposes a novel technique that collects information about all blood vessels that present in the retinal image and identifies the true vessel in a retinal image. In the proposed method, first the input image is choose and the blood vessels are segmented. From that the crossover point detection is applied to detect the vessels which are crossing each other by using the window with the neighboring pixels.

4. RECOGNITION APPROACHES

4.1 SVM

In machine learning, **support vector machines** (**SVMs**, also **support vector networks**) are supervised learning models with associated learning algorithms that analyze data and recognize patterns, used for classification and regression analysis. Given a set of training examples, each marked as belonging to one of two categories, an SVM training algorithm builds a model that assigns new examples into one category or the other, making it a non-probabilistic binary linear classifier. An SVM model is a representation of the examples as points in space, mapped so that the examples of the separate categories are divided by a clear gap that is as wide as possible. New examples are then mapped into that same space and predicted to belong to a category based on which side of the gap they fall on.

In addition to performing linear classification, SVMs can efficiently perform a non-linear classification using what is called the kernel trick, implicitly mapping their inputs into high-dimensional feature spaces.

4.2 HMM

We describe an embedded hidden Markov model (HMM)-based approach for face detection and recognition that uses an efficient set of observation vectors obtained from the 2D-DCT coefficients. The embedded HMM can model the two dimensional data better than the one-dimensional HMM and is computationally less complex than the two-dimensional HMM. This model is appropriate for face images since it exploits an important facial characteristic: frontal faces preserve the same structure of “super states” from top to bottom, and also the same left-to-right structure of “states” inside each of these “super states”.

4.3 DCT

In the field of image processing and recognition, discrete cosine transform (DCT) and linear discrimination are two widely used techniques. Based on them, we present a new face and palmprint recognition approach in this paper. It first uses a two-dimensional separability judgement to select the DCT frequency bands with favorable linear separability. Then from the selected bands, it extracts the linear discriminative features by an improved Fisherface method and performs the classification by the nearest neighbor classifier. We detailedly analyze theoretical advantages of our approach in feature extraction. The experiments on face databases and palmprint database demonstrate that compared to the state-of-the-art linear discrimination methods, our approach obtains better classification performance. It can significantly improve the recognition rates for face and palmprint data and effectively reduce the dimension of feature space.

4.4 PCA

A new technique coined two-dimensional principal component analysis (2DPCA) is developed for image representation. As opposed to PCA, 2DPCA is based on 2D image matrices rather than 1D vectors so the image matrix does not need to be transformed into a vector prior to feature extraction. Instead, an image covariance matrix is constructed directly using the original image matrices, and its eigenvectors are derived for image feature extraction. To test 2DPCA and evaluate its performance, a series of experiments were performed on three face image databases: ORL, AR, and Yale face databases. The recognition rate across all trials was higher using 2DPCA than PCA. The experimental results also indicated that the extraction of image features is computationally more efficient using 2DPCA than PCA.

5. Conclusion

The paper has defined a work on medical image processing and disease recognition. The paper has defined the basic filteration model to improve the image features so that effective disease recognition will be done. Paper also described the work on disease recognition and classification approaches.

References

[1] KEITH P. THOMPSON," Therapeutic and Diagnostic Application of Lasers in Ophthalmology", 0018-9219/92@1992 IEEE

[2] Jim Beach," Spectral Reflectance Technique for Retinal Blood Oxygen Evaluation in Humans", Proceedings of the 31st Applied Imagery Pattern Recognition Workshop (AIPR.02) 0-7695-1863-X/02 © 2002 IEEE

[3] Kevin Noronha," Enhancement of retinal fundus Image to highlight the features for detection of abnormal eyes", 1-4244-0549-1/06 ©2006 IEEE.

[4] Sangyeol Lee," Validation of Retinal Image Registration Algorithms by a Projective Imaging Distortion Model", Proceedings of the 29th Annual International Conference of the IEEE EMBS 1-4244-0788-5/07 ©2007 IEEE

[5] S. Sekhar," AUTOMATED LOCALISATION OF RETINAL OPTIC DISK USING HOUGH TRANSFORM", ISBI 2008 978-1-4244-2003-2/08 ©2008 IEEE

[6] Zhuo Zhang," ORIGA-light : An Online Retinal Fundus Image Database for Glaucoma Analysis and Research", 32nd Annual International Conference of the IEEE EMBS 978-1-4244-4124-2/10 ©2010 IEEE

[7] Michael D. Abràmoff," Retinal Imaging and Image Analysis", IEEE REVIEWS IN BIOMEDICAL ENGINEERING 1937-3333 © 2010 IEEE

[8] Vahabi Z," The new approach to Automatic detection of Optic Disc from non-dilated retinal images", Proceedings of the 17th Iranian Conference of Biomedical Engineering (ICBME2010) 978-1-4244-7484-4/10© 2010 IEEE

[9] Zafer Yavuz," RETINAL BLOOD VESSEL SEGMENTATION USING GABOR FILTER AND TOPHAT TRANSFORM", 2011 IEEE 19th Signal Processing and Communications Applications Conference (SIU 2011) 978-1-4577-0463-511/11 ©2011 IEEE

[10] MARYAM MUBBASHAR," Automated System for Macula Detection in Digital Retinal Images".

[11] K.Sangeetha," Advanced Analysis of Anatomical Structures Using Hull Based Neuro-Retinal Optic Cup Ellipse Optimization in Glaucoma Diagnosis", 2012 International Conference on Computer Communication and Informatics (ICCCI -2012), 978-1-4577-1583-9/ 12 © 2012 IEEE

[12] Nilan jan Dey," Optical Cup to Disc Ratio Measurement for Glaucoma Diagnosis Using Harris Corner", ICCCNT12

[13] R. Geetha Ramani," Automatic Prediction of Diabetic Retinopathy and Glaucoma through Retinal Image Analysis and Data Mining Techniques", 978-1-4673-2322-2/12 ©2012 IEEE

[14] ManjulaSri Rayudu," Review of Image Processing Techniques for Automatic Detection of Eye Diseases", 2012 Sixth International Conference on Sensing Technology (ICST) 978-1-4673-2248-5/12 ©2012 IEEE

[15] Kumar Parasuraman, “Automated Detection of Diseases by Nicking Quantification in Retinal Images”, INTERNATIONAL CONFERENCE ON ELECTRONICS, COMMUNICATION AND COMPUTATIONAL ENGINEERING, pp 1303-1308, 2014

[16] Riries Rulaningtyas and Khusnul Ain, “EDGE DETECTION FOR GLAUCOMA PATTERN RECOGNITION”,

[17] Ehab F. Badran, Esraa Galal Mahmoud, and Nadder Hamdy, “An Algorithm for Detecting Glaucomas in MRI Images”, 978-1-4244-7042-6/10 ©2010 IEEE

[18] N. Nandha Gopal , Dr. M. Karnan, “Diagnose Glaucoma Through MRI Using Image Processing Clustering Algorithms Such As Fuzzy C Means Along With Intelligent Optimization Techniques”, 978-1-4244-5967-4/10 ©2010 IEEE

[19] Yanqing Xue, Shuicai Wu, Hongjian Gao, “Three Dimensional Visualization and Analysis of Glaucoma”. 2011 4th International Conference on Biomedical Engineering and Informatics (BMEI)

[20] T.Logeswari, M.KARNAN, “An Enhanced Implementation of Glaucoma Detection Using Segmentation Based on Soft Computing”, 2010 International Conference on Signal Acquisition and Processing 978-0-7695-3960-7/10 © 2010 IEEE