A Survey on Retinal Area Detector From Scanning Laser Ophthalmoscope (SLO) Images for Diagnosing Retinal Diseases

Ms. SARIKA SAMBHAJIRAO KADAM[1], Mr. SANTOSH D. KALE[2]

[1]PG Scholar , Department of Electronics and Telecommunication, SVPM College of Engineering, Malegaon (BK), Maharashtra, India.

[2]Assistant Professor , Department of Electronics and Telecommunication, SVPM College of Engineering, Malegaon (BK), Maharashtra, India.

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Abstract: *Distinguishing the true retinal area from artefacts in SLO images is a challenging task and first important step towards computer-aided disease diagnosis. Retinal diseases are fatal and have to be detected and treated during the early stages itself otherwise it result in the loss of eyesight. The purpose of the retina is to receive the light that is focused from lens, convert it into neural signals, and send these signals to the brain for visual recognition. The retina deal with a picture from the focused light, and the brain decide what the picture is. Hence the retina plays important role in vision, damage to it can also cause problems such as permanent blindness. So we find out whether a retina is true or not for the detection of retinal diseases. This paper focuses survey on automatically extract out true retinal area from an SLO image based on image processing. And further the retinal area is used to classify the retinal disorder based on machine learning approaches.*

***Keywords*: Feature selection, scanning laser ophthalmoscope (SLO), retinal artefacts extraction, retinal image analysis, retinal Disorders.**

1. INTRODUCTION

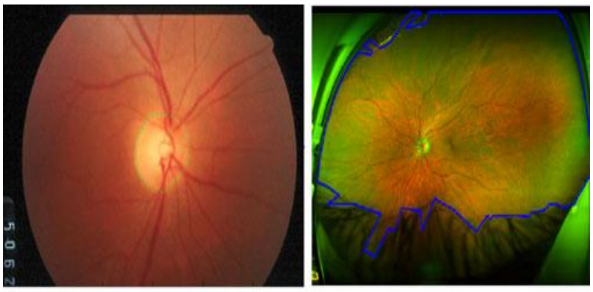
In the early treatments of retinal eye diseases we avoid the vision loss. Hence focus is always on correctly segment artifacts from the retinal eye image. In the retinal area detection there are extraneous objects involved like localization of eyelids, eyelashes and dust (EED) on optical surfaces. That may appear in focus. So, Automatic segmentation of these artifacts from a retinal image is an important task. EED locating retina is a key task because the major part of the retina is almost partially occluded by artifacts, which will increase the danger of faulty acceptance and faulty recognition if not excluded properly. Identification of retinal diseases is based on manual observations technique. Patients eye are captured using fundus camera or scanning laser ophthalmoscope. Optometrists and ophthalmologists always depend on image operations such as change of contrast and zooming to clarify these images and diagnose results based on their own experience and knowledge. Automated analysis of retinal images reduce the time that the clinicians need for looking at images which can expect more patients to be screened out and more consistent diagnoses can be given in time efficient manner. The purpose of performing this study is to develop a method that can exclude artifacts from retinal scans so as to improve automatic detection of disease features from the retinal scans. Hence this paper constructed a novel framework for the extraction of retinal area in SLO images which contains three main parts-

1) Determination of the features that can be distinguishes between the retinal area and the artifacts;

2) Selection of features which are most suitable to the classification;

3) Construction of the classifier for classifying the retinal area from SLO images.

Different imaging features such as structural, textural, grey level information at various resolutions is used to differentiate the retinal area and the artifacts. Finally, we have constructed the classifier for selecting between the retinal area and the artifacts.



(a) (b)

Fig.1- Example of (a) A fundus image and (b) An SLO image annotated with true retinal area.

2. RELATED WORKS

2.1 LITERATURE SURVEY:

There are several image based features which have been represent different retinal structures in fundus images such as color, illumination, intensity, skewness, texture, histogram, sharpness etc.

A. Super-pixel Classification Based Optic Disc and Optic Cup Segmentation for Glaucoma Screening, J. Cheng, J. Liu, Y. Xu, F. Yin, D. Wong, [2] proposed segmentation methods have been estimated in a database of 650 images with optic disc and optic cup boundaries manually marked by trained professionals. Experimental results show an average overlapping error of 9.5% in optic disc and 24.1% in optic cup segmentation. The results also show an increase in overlapping error as the reliability score is reduced, which justifies the effectiveness of the self-assessment. The segmented optic disc and optic cup are then utilized to compute the cup to disc ratio for glaucoma screening.

B. Retinal Fundus Image Analysis for Diagnosis of Glaucoma, M. Caroline Viola Stella Mary, Elijah Blessing Rajsingh, Ganesh R. Naik, [8] proposed the retinal images provide vital information about the true sensory part of the visual system. Retinal disorders like glaucoma, diabetic retinopathy, age related macular degeneration, retinopathy of prematurity that can lead to blindness as artifacts in the retinal image. An automated system can be used for offering standardized large-scale screening at a low cost which may reduce human errors, provide services to remote areas, as well as free from observer bias and fatigue. Treatment of retinal diseases are available; the challenge lies in finding a cost effective approach with high sensitivity and specificity that can be used to huge population in a timely manner to identify those who are at risk in the early stages of the disease.

C. Automated image quality evaluation of retinal fundus photographs in diabetic retinopathy screening, H. Yu, C. Agurto, S. Barriga, S. C. Nemeth, P. Soliz, and G. Zamora [7] presents a system that can automatically determine whether the quality of a retinal image is adequate for computer-based diabetic retinopathy (DR) screening. The system integrates global histogram features, textural features, vessel density and local non-reference perceptual sharpness metric. A partial least square (PLS) classifier is trained to differentiate low quality images from normal quality images.

D. Splat feature classification with application to retinal hemorrhage detection in fundus images, Li Tang, Meindert Niemeijer, Joseph M. Reinhardt [3] presents a novel splat feature classification method to retinal hemorrhage detection in fundus images. True detection of retinal hemorrhages is important in the development of automated screening systems. Under supervised approach, retinal color images are divided into non-overlapping segments covering the entire image. Each segment, contains pixels with similar color and spatial location. A set of features is extracted from each segment to describe its characteristics relative to its surroundings, employing responses from a various of filter bank, interactions with neighboring segments , and shape and texture information. An optimal subset of splat features is chosen by a filter method followed by a wrapper technique. A classifier is trained with splat-based expert annotations and estimated on the publicly available Messidor dataset.

2.2 PROPOSED SYSTEM

Proposed system is based on analyzing the SLO image-based features, which are calculated for a small region in the retinal image called super-pixels. The feature vector determined for each super-pixel is computationally efficient as compared to feature vector determination for each pixel. The super-pixels from the images in the training set are assigned the class of either retinal area or artifacts based on the majority of pixels in the super-pixel belonging to the specific class. The classification is done after ranking and selection of features in terms of effectiveness in classification.

3. SYSTEM FRAMEWORK:

The block diagram of the retinal area detector framework is shown in Fig.2. The framework contains three stages, namely training stage, testing and evaluation stage, and deployment stage. In the training stage it build the classification model based

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on training images and showing the boundary around the retinal area. In the testing and evaluation stages, Neural Network is used for training and testing of pre-processed images. Carefully select the database of color retinal images at different stages. In the deployment stage performs the automatic extraction of the retinal area from artifacts. Finally it diagnosis the retinal disorders from the input images by comparing it with the database images. System framework is briefly explained as follows:

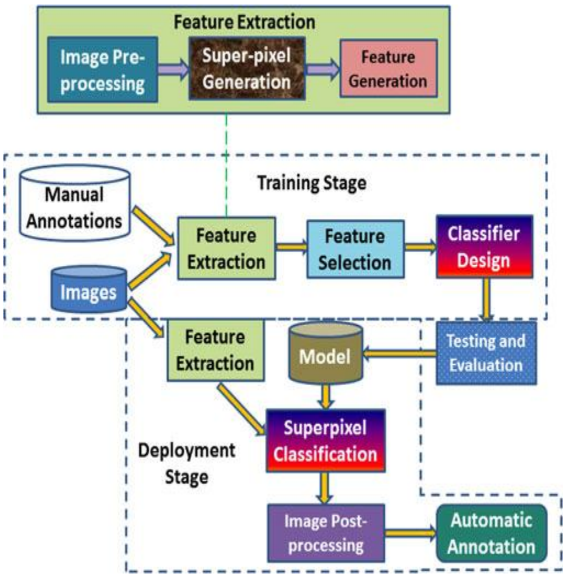

Fig.- 2 Block diagram of retina detector framework

Image Data Integration: Data integration involves the combining or merging of data from multiple sources in an effort to extract better and more information It includes the integration of image data with their manual annotations around true retinal area.

Image Preprocessing: Images are then preprocessed in order to bring the intensity values of each image into a specific range. Image pre-processing is equivalent to the mathematical normalization of a data set.

Generation of Super-pixels: The training images after preprocessing are divided into small regions called super-pixels. The generation of the feature vector for each super-pixel makes the process computationally capable and it should be fast to compute, memory efficient, and simple to use.

Feature Generation: We generate image-based features which are used to differentiate between the retinal area and the artefacts. The image-based features like textural, gray scale, or regional information and they were calculated for each super-pixel of the image available in the training set. In testing stage, only those features are generated which are selected by feature selection process.

Feature Selection: Because of a large number of features, the feature array needs to be minimized before classifier construction. This involves features selection of the most important features used for classification.

Classifier Construction: In association with manual annotations, the selected features are then used to construct the binary classifier. The output of such a classifier is the super-pixel representing either the true retinal area or the artifacts.

Image Post-processing: Image post-processing is performed by morphological filtering to determine the retinal area boundary using super-pixels which are classified by the classification model.

3.2 ADVANTAGES

- The importance of using SLO is its wide field of view, which can image a large part of the retina for better diagnosis of the retinal diseases
- During the imaging process, artefacts such as eyelashes as well as eyelids are imaged along with the retinal area
- Minimize the complexity of image processing tasks and provide a convenient primitive image pattern
- An automated system can be used for offering standardized large-scale screening at a lower cost which may reduce human errors
- The challenge lies in finding a cost effective approach with high sensitivity

3.3 APPLICATIONS

- Widely used in the diagnosis and management of patients with diabetic retinopathy, macular degeneration, and inflammatory retinal diseases.
- Retinal recognition has primarily been used in combination with access control systems at high security facilities. This used in military installations, nuclear facilities, and laboratories.
- Identify those who are at risk in the early stages of the disease.
- Treatment of retinal diseases which are available.

4. CONCLUSION

This paper focuses on survey of techniques for distinguishing true retinal area from artefacts in SLO images is a challenging task, which is also the first important step towards computer-aided disease diagnosis image based feature set for automatic detection of retinal area in SLO images. Paper present super-pixels to represent different irregular regions in a compact way and reduce the computing cost. A classifier has been built based on selected features to extract out true retinal area.

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BIOGRAPHIES:

Ms. SARIKA SAMBHAJIRAO KADAM:
Pursing Master Engineering (M.E.E&TC) in Digital System, Savitribai phule Pune University / SVPM College of Engineering Malegaon (BK), Baramati, *Maharashtra,* India.

Santosh D. Kale:- currently working as a Assistant Professor at college of engineering, Malegaon (Bk), Baramati. He received B.E. Degree in Electronics & Telecommunication in 2001, from North Maharashtra University of Jalgaon, Maharashtra, India. he received M.Tech Degree in (Electronics Instrumentation) in Electronics & Telecommunication, from college of Engineering, Pune(COEP),India, he guided several UG & PG projects. his research area includes signal and image processing.