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Automatic extraction of retinal features from colour retinal images using generic image quality indicators

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ABSTRACT

Our vision reduced in eye due to the presence of Retinal diseases like DR (diabetic Retinopathy) and Blood vessel damage. This project mainly concentrates on the symptoms of retinal problems identification using Retinal fundus images. Our proposed work shows that how the artefacts such as eyelashes and eyelids are removed for true retinal area extraction and for detection of disease called Diabetic Retinopathy(DR) based on image processing and machine learning approaches. Diabetic retinopathy is the disorder of an eye mostly observed in the diabetes patient. Excluding the artefacts from the retinal image is the big challenge. So the first step is to eliminate the artefacts and followed by disease detection.

Keywords: Intra-Ocular Pressure (IOP), Diabetic Retinopathy (DR), Simple Linear Iterative Clustering (SLIC)

1. INTRODUCTION

Color retinal photography is an important tool to detect various eye diseases. The first cause of blindness in India and worldwide is recognized as Diabetic retinopathy, which is disorder of an eye caused by diabetes. It is damage occurs to the retina due to diabetes. It is eventually leads to blindness. It is an ocular manifestation of diabetes, a systematic disease, which affects up to 80% of all patients shown in fig 1 & 2.

Currently, the images of retina are obtained using fundus camera. Large amount of images can be obtained for screenings using fundus camera for detection of the pathological diseases shown in fig 3.Hemorrhage is defined as an escape of blood from ruptured blood vessel. Ischemia is a term used to describe a tissue whose blood supply has been reduced to an insufficient level. Lack of O_2 in the retinal tissue may lead to retinal cell death and result in reduced vision. Microaneursym is a tiny area of blood protruding from an artery or vein in the back of eye. These protrusions may open and leak blood into the retinal tissue surrounding it. Vascular

Figure 1: Normal vision & diabetic retinopathy vision

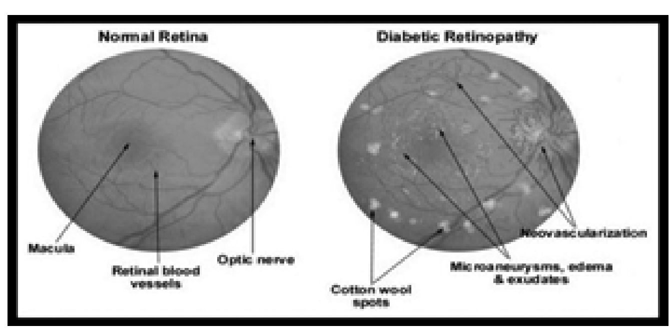

Figure 2: normal retina and diabetic retinopathy

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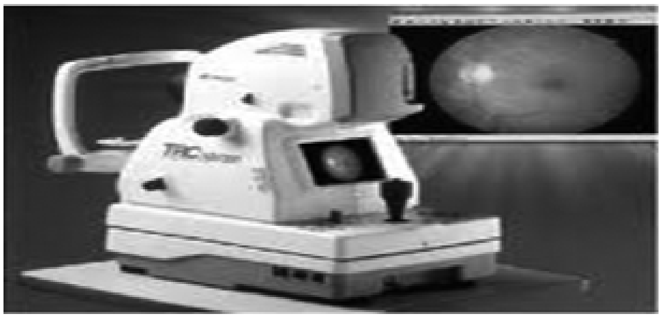

Figure 3: Example of fundus camera

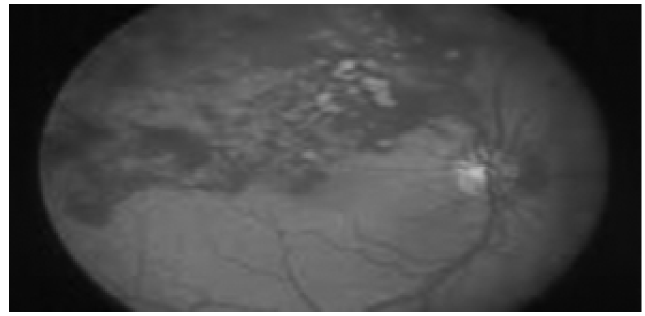

Figure 4: Retina with hemorrhage formation

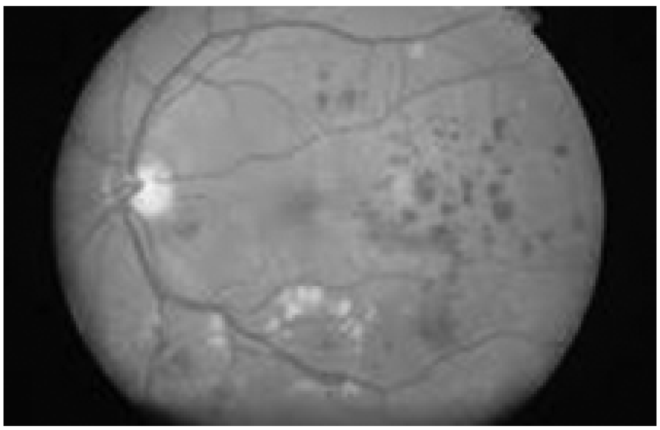

Figure 5: Retina with micro aneurysm formation

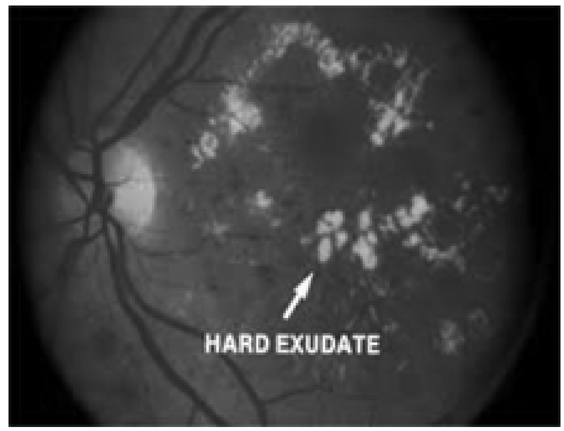

Figure 6: Retina with exudates formation

disease, high BP and Diabetes mellitus shown in figure 5. Exudates marked by the masses of white or yellowish layer in the posterior part of the fundus oculi, with deposit of cholestrin and blood debris from retinal hemorrhage.Leading to destruction of macula and blindness shown in figure 6.

2. LITERATURE SURVEY

Glaucoma is a group of eye diseases that have common traits such as, high eye pressure, damage to the Optic Nerve Head and gradual vision loss. It affects peripheral vision and eventually leads to blindness if left untreated. The current common methods of pre-diagnosis of Glaucoma include measurement of Intra-Ocular Pressure (IOP) using Tonometer, Pachymetry, Gonioscopy; which are performed manually by the clinicians. These tests are usually followed by Optic Nerve Head (ONH) Appearance examination for the confirmed diagnosis of Glaucoma. The diagnoses require regular monitoring, which is costly and time consuming. The accuracy and reliability of diagnosis is limited by the domain knowledge of different ophthalmologists. Therefore automatic diagnosis of Glaucoma attracts a lot of attention [1,11]. The presents a system that can automatically determine whether the quality of a retinal image is sufficient for computer-based diabetic retinopathy (DR) screening. The system integrates global histogram features, textural features, and vessel density, as well as a local non-reference perceptual sharpness metric. A partial least square (PLS) classifier is trained to distinguish low quality images from normal quality images. The system was evaluated on a large, representative set of 1884 non-mydriatic retinal images from 412 subjects. An area under the ROC curve of 96% was achieved[2].A retinal image gradability assessment algorithm based on the fusion of generic image quality indicators is introduced. Four features quantifying image colour, focus, contrast and illumination are computed using novel image processing techniques. These quality indicators are also combined and classified to evaluate the image suitability for diagnostic purposes. The algorithm performance is thoroughly appraised through comparison of the automatic classification results of 2032 retinal images from proprietary, DRIVE, Messidor, ROC and STARE datasets with human made classification, revealing a sensitivity of 99.76% and a specificity of 99.49%. The algorithm computational complexity and sensitivity to image noise and resolution were also experimentally quantified demonstrating very good performance and confirming the usability of the solution in an ambulatory application environment[3]. Sufficient image quality is a necessary prerequisite for reliable automatic detection systems in several healthcare environments. Specifically for Diabetic Retinopathy (DR) detection, poor quality fund us makes more difficult the analysis of discontinuities that characterize lesions, as well as to generate evidence that can incorrectly diagnose the presence of anomalies. Several methods have been applied for classification of image quality and recently, have shown satisfactory results. However, most of the authors have focused only on the visibility of blood vessels through detection of blurring. Furthermore, these studies frequently only used fund us images from specific cameras which are not validated on datasets obtained from different retinographers. In this paper, we propose an approach to verify essential requirements of retinal image quality for DR screening: field definition and blur detection. The methods were developed and validated on two large, representative datasets collected by different cameras. The first dataset comprises 5,776 images and the second, 920 images. For field definition, the method yields a performance close to optimal with an area under the Receiver Operating Characteristic curve (ROC) of 96.0%. For blur detection, the method achieves an area under the ROC curve of 95.5% [4, 9]. Computer vision applications have come to rely increasingly on super pixels in recent years, but it is not always clear what constitutes a good super pixel algorithm. In an effort to understand the benefits and drawbacks of existing methods, we empirically compare five state-of-the-art super pixel algorithms for their ability to adhere to image boundaries, speed, memory efficiency, and their impact on segmentation performance. We then introduce a new super pixel algorithm, simple linear iterative clustering (SLIC), which adapts a k-means clustering approach to efficiently generate super pixels. Despite its simplicity, SLIC adheres to boundaries as well as or better than previous methods. At the same time, it is faster and more memory efficient, improves segmentation performance, and is straightforward to extend to supervoxel generation [5]. Noise removal is a very important step in an iris segmentation process. Iris regions are usually occluded by Eyelid and eyelashes. For overcome this problem, we present a robust method for eyelid and eyelashes segmentation based on wavelet transform. Our approach follows two main stages. First, eyelashes are removed using wavelet transform. Then eyelids boundary are modeled with a parabolic curve. Second, Eyelashes are modeled by Hough transform. Afterwards eyelashes are segmented using neural network. Experimental results on a set of 756 images show that the accuracy of proposed method leading to accurate eyelid and eyelash segmentation [6]. It represents novel iris recognition technique which uses textural and

topological features. Converting circular iris pattern into rectangular pattern makes it rotation invariant. Most of the research in iris recognition is on encoding and recognition of iris pattern but segmenting exact iris pattern is itself very tedious task in this paper we are trying to emphasize on better iris segmentation technique. In other systems performance of the system is always dependent on threshold. There is always conflict between FAR & FRR [7, 10]. Automated, objective and fast measurement of the image quality of single retinal fundus photos to allow a stable and reliable medical evaluation. The proposed technique maps diagnosis-relevant criteria inspired by diagnosis procedures based on the advice of an eye expert to quantitative and objective features related to image quality. Independent from segmentation methods it combines global clustering with local sharpness and texture features for classification [8, 9].

3. PROPOSED SYSTEM

In existing system used neural network technique for exclude artefacts such as eyelid & eyelashes using SLO (SCANNING LASRE OPTHALMOSCOPE). The SLO image is taken with the help of fundus camera. In proposed system use the same input from existing system, to exlude artefacts using advent technique "FUZZY LOGIC**"** which gives accurate result because it consists 0's & 1's, additionally we detect disease in the extracted retina. So this two process is followed by using the technique fuzzy logic shown in fig 7.

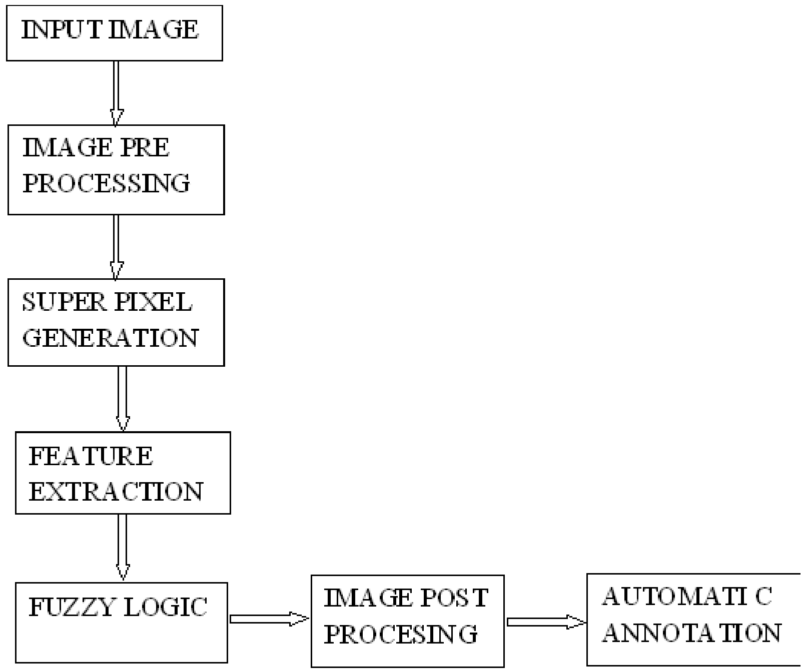

Figure 7: Block diagram for retinal area detector

3.1. Input Image

In the input image, the SLO image with artefacts is given to the input image of this paper. Here we give two input images they are diseased image and un diseased image. Both images are given two the input of image pre-processing shown in figure 8 &9.

3.2. Image Pre Processing

The aim of pre–processing is an improvement of image data that features important for further processing. To correct some degradation in image. The pre-processing is the technique of enhancing data images prior to computational processing. In pre processing using the median filter to remove the noise in the input image. Improving the visual appearance of images. Pre processing is common name for operations with images at the lowest level of abstraction–both input and output are intensity images. It does not increase image information content. They are some pixel brightness transformations and local pre processing methods realized in MATLAB. “Pre processing images common involves removing low–frequency. Background noise, normalizing the intensity of the individual particles images, removing reflections, and masking portion of images showed in figure 8& 9. Image pre processing is the technique of enhancing data images prior to computational” The image pre processing mainly used for removal of noise, that process done in two ways : Addition of noise or filter here we used median filter because we take only middle value and this filter is used to remove the “salt and pepper noise”. The input image is given to the first step of pre processing, here the rgb image is converted in to gray scale image and binary image for the purpose of fast computing and reduce the time complexity. And generally image consists some noise. In our paper take only the median value (i.e. middle value) so we only remove the salt and pepper noise it is commonly in the median filter. Te median filter play an imporantant role in our paper.

Preprocessing is an important and diverse set of image preparation programs that act to offset problems with the band data and recalculate DN values that minimize these problems. Among the programs that optimize these values are atmospheric correction An estimate of the new brightness value that is closer to the B condition is made by some mathematical resampling technique. Three sampling algorithms are commonly used.

3.3. Median Filter

In signal processing, it is often desirable to be able to perform some kind of noise reduction on an image or signal. The median filter is a nonlinear digital filtering technique, often used to remove noise. Such noise reduction is a typical pre-processing step to improve the results of later processing (for example, edge detection on an image). Median filtering is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise.The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighboring entries.

3.4. Salt and Pepper Noise

Salt and pepper noise is a form of noise sometimes seen on images It presents itself as sparsely occurring white and black pixels. An affective noise reduction method for this type of noise is a median filter. It also known as impulse noise. This noise can be caused by sharp & sudden disturbances in the image signal. Its appearance is randomly scattered white or black (or both) pixel over the image shown in figure10&11.

3.5. Superpixel Generation

Superpixel segmentation is an increasingly popular image preprocessing technique used in many computer vision applications such as image segmentation, image parsing, object tracking, and 3D reconstruction. It

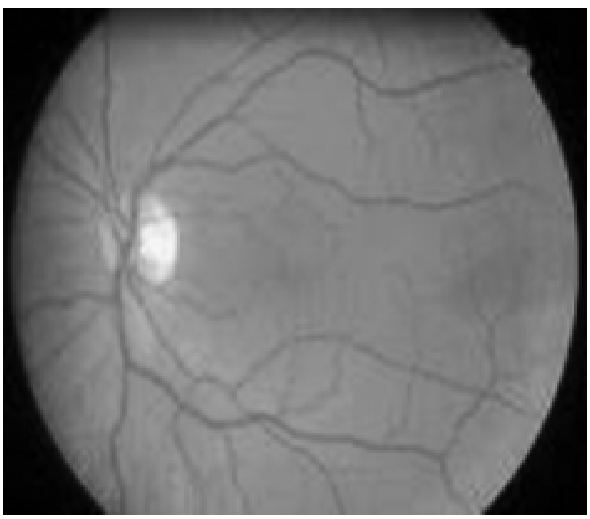

Figure 8: color image

Figure 9: gray scale image

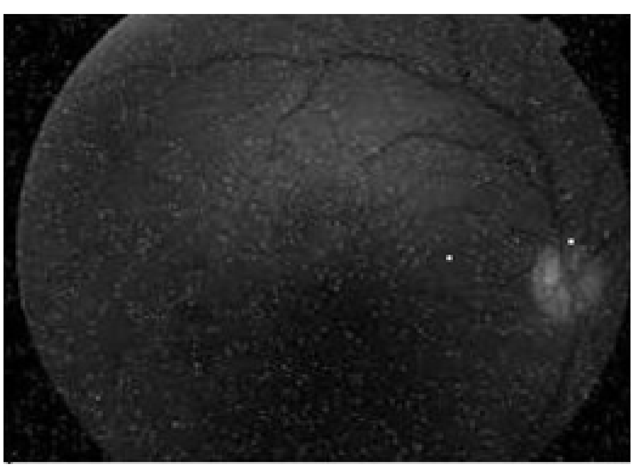

Figure 10: salt and pepper noise in gray scale

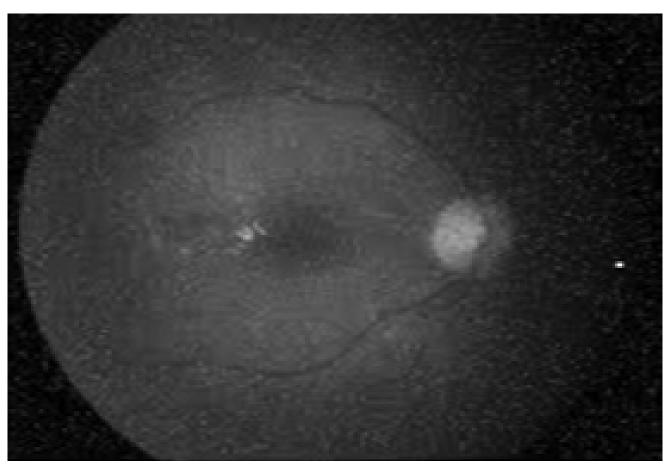

Figure 11: salt and pepper noise in color image.

provides a concise image representation by grouping pixels into perceptually meaningful small patches that adhere well to object boundaries. Comparing to the pixel-rigid image representation, superpixel is more consistent with human visual cognition and contains less redundancy. as a preprocessing technique for improving efficiency of computer vision tasks, superpixel segmentation should be of low complexity itself. Last but not the least, global image information which is important for human vision cognition should be considered appropriately. It is critical for a segmentation process to utilize the perceptually important non-local clues to group unrelated image pixels into semantically meaningful regions. Nevertheless, considering global relationship among pixels usually lead to substantial increases in computational complexity. are mainly based on the analysis of local image information only.

3.6. Feature Extration

In generally, feature extraction involves reducing the amount of resources to describe a large set of data. In this paper, For diagnosing retinal diseases of DIABETIC RETINOPATHY, feature extraction is followed for this process we give thirteen input to determine diseased image. Next step is feature extraction in this stage where using features like AREA, BLOB, PERIMETER, CENTORIDS AND GLCM FEATURE.(gray level co-occurance matrix) feature extraction is followed for this process we give thirteen input to determine diseased image.

3.7. Fuzzy Logic

Fuzzy logic is a form of many-valued logic in which the truth values of variables may be any real number between 0 and 1, considered to be “fuzzy”. By contrast, in Boolean logic, the truth values of variables may only be 0 or 1, often called “crisp” values. Fuzzy logic has been extended to handle the concept of partial truth, where the truth value may range between completely true and completely false. Furthermore, when linguistic variables are used, these degrees may be managed by specific (membership) functions. Classical logic only permits conclusions which are either true or false. For example, the notion that 1+1=2 is a fundamental mathematical truth. However, there are also propositions with variable answers, such as one might find when asking a group of people to identify a colour. In such instances, the truth appears as the result of reasoning from inexact or partial knowledge in which the sampled answers are mapped on a spectrum.In the case where someone is tossing an object into a container from a distance, the person does not compute exact values for the object weight, density, distance, direction, container height and width, and air resistance to determine the force and angle to toss the object.

3.8. Image Post Processing

Image post processing is performed by morphological operation so as to determine the retinal area boundary using super pixels. The image post processing is very important in this paper because segmentation is processed in this stage and the final results is labled like exclude artefacts in retinal area and diseased area are separately displayed in output image. This all process is done by morphological operation.

3.9. Automatic Annotation

Automatic image annotation (also known as automatic image tagging or linguistic indexing) is the process by which a computer system automatically assigns metadata in the form of captioning or keywords to a digital image. This application of computer vision techniques is used in image retrieval systems to organize and locate images of interest from a database.

This method can be regarded as a type of multi-class image classification with a very large number of classes-as large as the vocabulary size. Typically, image analysis in the form of extracted feature vectors and the training annotation words are used by machine learning techniques to attempt to automatically apply annotations to new images. The first methods learned the correlations between image features and training annotations, then techniques were developed using machine translation to try to translate the textual vocabulary with the ‘visual vocabulary’, or clustered regions known as *blobs*. Work following these efforts has included classification approaches, relevance models and so on. shown in figure 12 & 13.

Certain image features in example images may override the concept that the user is really focusing on. The traditional methods of image retrieval such as those used by libraries have relied on manually annotated images, which is expensive and time-consuming, especially given the large and constantly growing image databases in existence.

4. EXPERIMENTAL RESULT-INPUT SLO IMAGE WITH ARTEFACTS

Initially the input is read on MATLAB. Then the image is cropped as show in the below screen shot. Input image is SLO(SCANNING LASER OPTHALMOSCOPE) with present of artefacts like eye lashes, eye lids in image here show that healthy image and diseases affect image.

4.1. Image Pre Processing

After giving the input image second step is image pre processing in this stage first convert the RGB image (red, green, blue) into gray scale image to make the calculation easy then futher using the MEDIAN filter is to remove the noise present in the image for both the healthy image and affected shown in fig14 & 15.

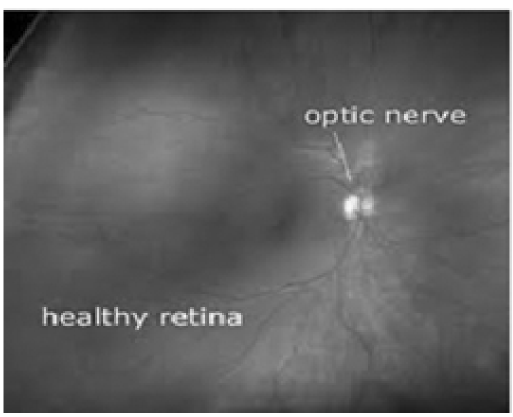

Figure 12: input image with artefacts (healthy image)

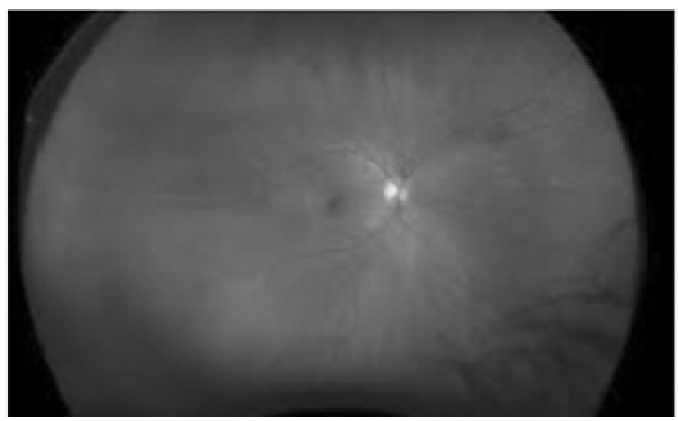

Figure13: input image with artefacts (disease affect image)

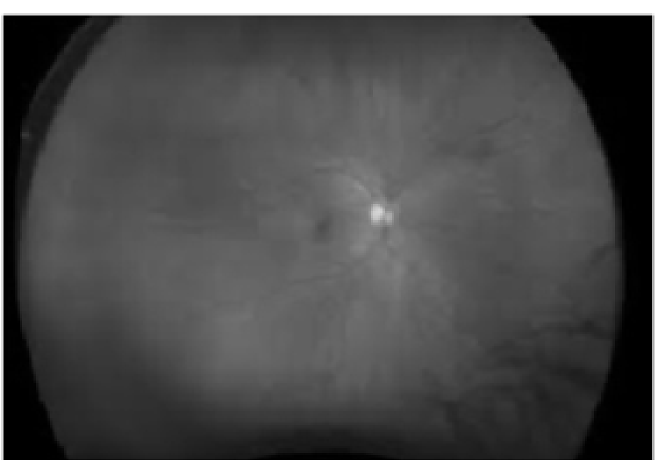

Figure 14: Image pre processing (healthy image)

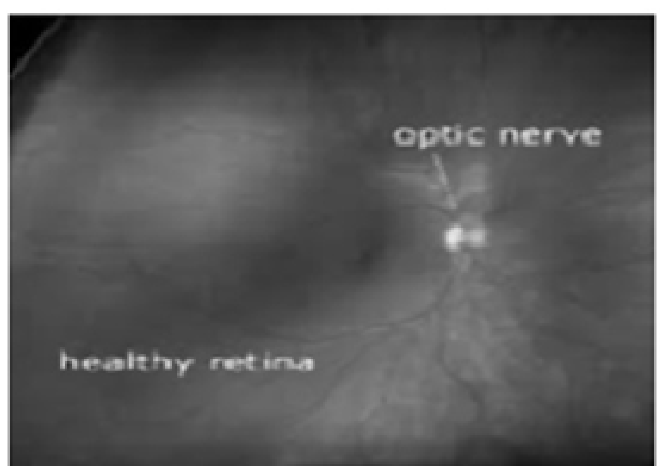

Figure15: Image pre processing (diseases affect image)

4.2. Feature Extraction

Next step is feature extraction in this stage where using features like AREA, PERIMETER, CENTORIDS AND GLCM FEATURE. Feature extraction is followed for this process we give thirteen input to determine diseased image. To the both healthy image and the affected image to check

4.3. Rule Viewer Fuzzy Ruleset

After the feature extraction step where the thirteen input given input to the fuzzy logic block where input of the fuzzy logic is an image only. While the 13 input is process in the fuzzy block where using rule viewer change the value of 13 symptoms output will be varies rule viewer is used to represent the symptom in value manner for the both healthy image and affected image to show varied value that affect part in retinal image thus show the wide different in between the healthy image and affected image shown in fig 18 & 19

5. Surface Viewer Fuzzy Rule Set

Surface viewer is used to represent the output of 13 symptoms in XYgraphical representation of both healthy image and affected image.

5.1. Degree of Membership

It is degree of membership graph where to giving Ix and Iy title using the Ix and Iy where giving coding that zero or not zero (i.e) one if Ix and Iy both are zero Iout is white surface area. If Ix and Iy are not zero then Iout is black surface area used for both healthy image and affected image shown in figure 20

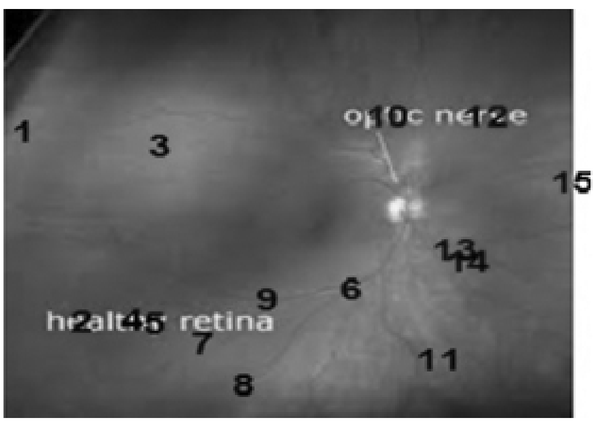

Figure 16: feature extraction (healthy image)

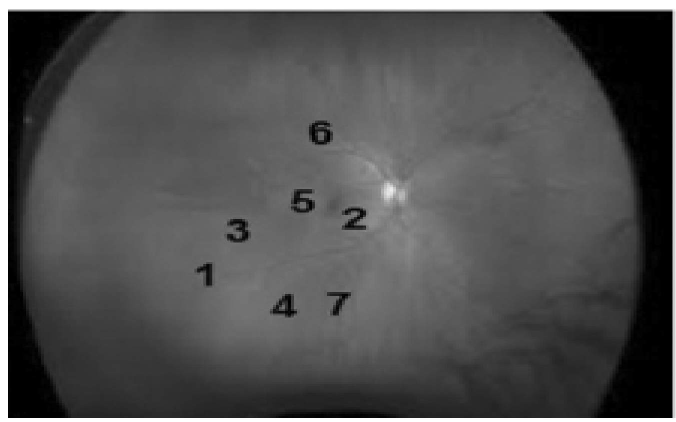

Figure 17: feature extraction (affected image)

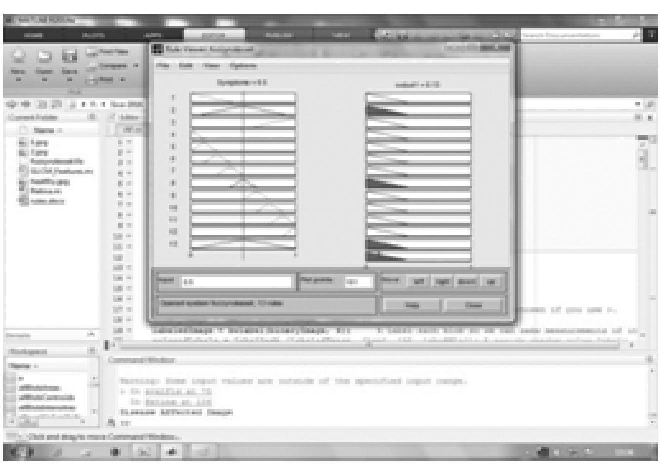

Figure 18: Rule viewer fuzzy rule set

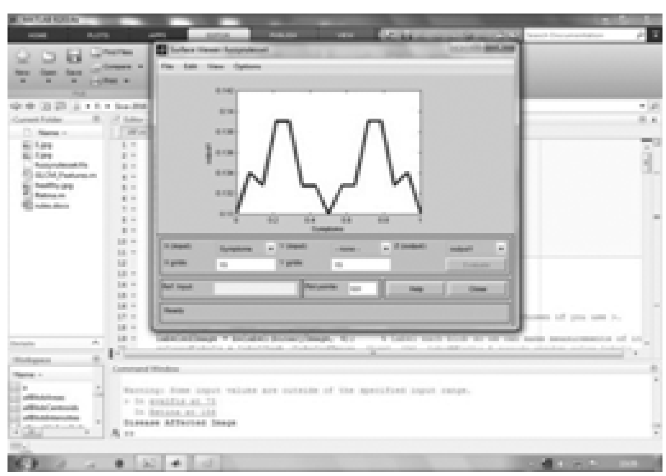

Figure 19: surface viewer fuzzy rules set

5.2. Applying Gradient

After the memebership function in fuzzy logic block where using the gradient method where the adding the gradient and level to both healthy image and affected image shown in figure 21 22

5.3. Image Post Processing

Image post processing is performed by morphological filtering so as to determine the retinal area boundary using super pixels classified by the classification model for both the healthy and affected image shown I figure 23 & 24.

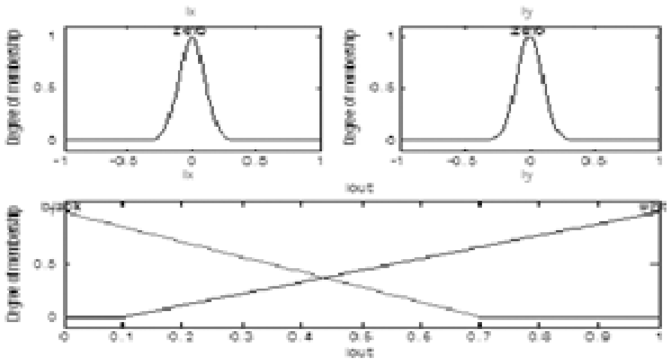

Figure 20: membership graph

Figure 21: applied gradient method in healthy image

Figure 22: applied gradient method in affected image

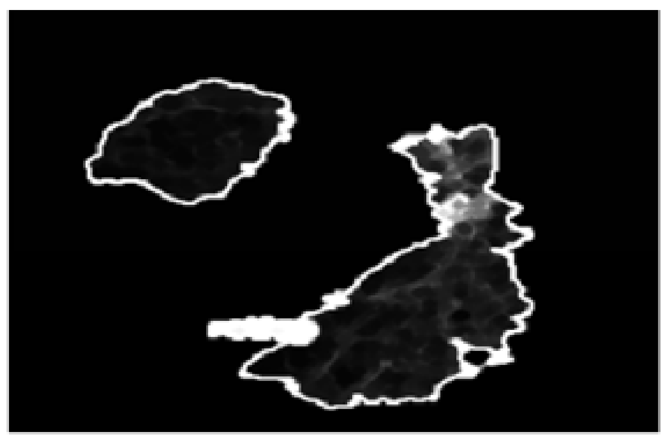

Figure 23: image post processing (healthy image)

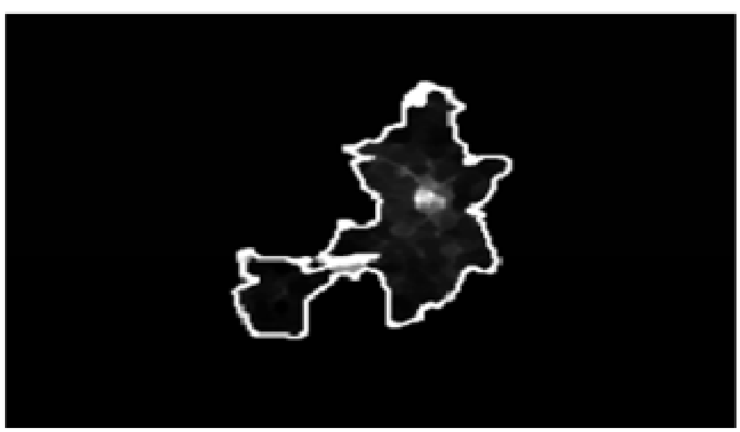

Figure 24: image post processing (affected image)

6. CONCLUSION

Biomedical image processing requires an integrated knowledge in mathematics, statistics, programming and Biology. This chapter outlines how different features of the fundus images namely blurred vision, spots in the vision, double vision which are the symptoms of Diabetic Retinopathy are identified using image processing techniques. The values obtained are essential as they represent the image and are necessary in order to classify the images accurately. Based on the result of the classsifier, this project has a sensitivity of 80% and specificity of 20%. It is able to achieve a fairly accurate classification for mild and higher stages, but not for normal class resulting in a possible high false alarm.This might be improved by fine tuning the threshold values used on the images and more images could be used to improve the overall system. In this paper, we learnt various techniques of image processing and to find texture properties like area, energy, contrast, correlation and homogenity from the fundus images.

REFERENCES

[1] M. S. Haleem, L. Han, J. van Hemert, and B. Li, (2013) "Automatic extraction of retinal features from colour retinal images for glaucoma diagnosis: A review," Comput. Med. Imag. Graph., vol. 37, pp. 581–596.

[2] H. Yu, C. Agurto, S. Barriga, S. C. Nemeth, P. Soliz, and G. Zamora, (2012) "Automated image quality evaluation of retinal fundus photographs in diabetic retinopathy screening," in Proc. IEEE Southwest Symp. Image Anal. Interpretation, pp. 125–128.

[3] J. A. M. P. Dias, C. M. Oliveira, and L. A. d. S. Cruz, (2012) "Retinal image quality assessment using generic image quality indicators," Inf. Fusion, vol. 13, pp. 1–18

[4] R. Pires, H. Jelinek, J.Wainer, and A. Rocha, (2012) "Retinal image quality analysis for automatic diabetic retinopathy detection," in Proc. 25th SIBGRAPI Conf. Graph., Patterns Images, pp. 229–236.

[5] Dr. AntoBennet, M, Sankar Babu G, Natarajan S, "Reverse Room Techniques for Irreversible Data Hiding ", Journal of Chemical and Pharmaceutical Sciences 08(03): 469-475, September 2015.

[6] Dr. AntoBennet, M, Sankaranarayanan S, Sankar Babu G, " Performance & Analysis of Effective Iris Recognition System Using Independent Component Analysis ", Journal of Chemical and Pharmaceutical Sciences 08(03): 571-576, August 2015.

[7] Dr. AntoBennet, M, Suresh R, Mohamed Sulaiman S, "Performance &analysis of automated removal of head movement artifacts in EEG using brain computer interface", Journal of Chemical and Pharmaceutical Research 07(08): 291-299, August 2015.

[8] Dr. AntoBennet, M "A Novel Effective Refined Histogram For Supervised Texure Classification", International Journal of Computer & Modern Technology, Issue 01, Volume02, pp 67-73, June 2015.

[9] Dr. AntoBennet, M, Srinath R, Raisha Banu A,"Development of Deblocking Architectures for block artifact reduction in videos", International Journal of Applied Engineering Research, Volume 10, Number 09 (2015) pp. 6985-6991, April 2015.

[10] AntoBennet, M & JacobRaglend, "Performance Analysis Of Filtering Schedule Using Deblocking Filter For The Reduction Of Block Artifacts From MPEQ Compressed Document Images", Journal of Computer Science, vol. 8, no. 9, pp. 1447-1454, 2012.

[11] Anto Bennet, M & JacobRaglend, "Performance Analysis of Block Artifact Reduction Scheme Using Pseudo Random Noise Mask Filtering", European Journal of Scientific Research, vol. 66 no. 1, pp. 120-129, 2011