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Detection and Classification of Retinal Lesions in Fundus Images

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ABSTRACT

The development of an automatic telemedicine system for computer-aided screening and grading of diabetic retinopathy depends on reliable detection of retinal lesions in retinal images. In this paper, a novel method for automatic detection of micro aneurysms, hemorrhages and exudates in color retinal images is described and validated. Initially, retinal images go with preprocessing step i.e. normalization, contrast enhancement, noise removal and optic disk removal. Then, color segmentation, thresholding and morphological models are propose for identify the lesions in retinal images. After the segmentation, extracts the color and texture features and these features were then fed to the classifier, K-nearest neighbour for classifying the lesions types. The experimental results show that the classification accuracy, sensitivity, specificity respectively.

Keywords:- kNN,Morphological model.

1. INTRODUCTION

What Is Image Processing?

Image processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. Usually Image Processing system includes treating images as two dimensional signals while applying already set signal processing methods to them.

It is among rapidly growing technologies today, with its applications in various aspects of a business. Image Processing forms core research area within engineering and computer science disciplines too.

Image processing basically includes the following three steps:

- Importing the image with optical scanner or by digital photography.
- Analyzing and manipulating the image which includes data compression and image enhancement and spotting patterns that are not to human eyes like satellite photographs.
- Output is the last stage in which result can be altered image or report that is based on image analysis.

Purpose of Image processing:

The purpose of image processing is divided into 5 groups. They are:

1. Visualization - Observe the objects that are not visible.
2. Image sharpening and restoration - To create a better image
3. Image retrieval - Seek for the image of interest.
4. Measurement of pattern – Measures various objects in an image.

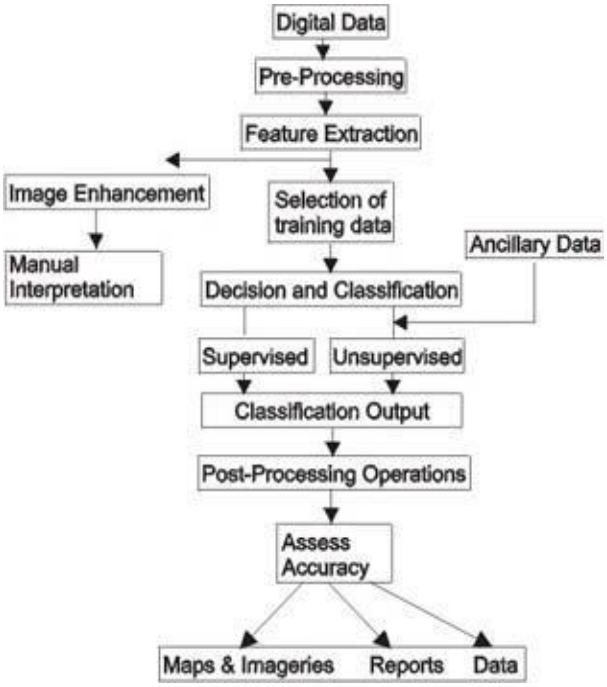
5. Image Recognition – Distinguish the objects in an image.

Types of Image Processing:

The two types of methods used for Image Processing are Analog and Digital Image Processing. Analog or visual techniques of image processing can be used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques. The image processing is not just confined to area that has to be studied but on knowledge of analyst. Association is another important tool in image processing through visual techniques. So analysts apply a combination of personal knowledge and collateral data to image processing.

Digital Processing techniques help in manipulation of the digital images by using computers. As raw data from imaging sensors from satellite platform contains deficiencies. To get over such flaws and to get originality of information, it has to undergo various phases of processing. The three general phases that all types of data have to undergo while using digital technique are Pre-processing, enhancement and display, information extraction.

Working diagram of Image Processing:



Characteristics of Image Processing:

Before going to processing an image, it is converted into a digital form. Digitization includes sampling of image and quantization of sampled values. After converting the image into bit information, processing is performed. This processing technique may be, Image enhancement, Image restoration, and Image compression.

Image enhancement:

It refers to accentuation, or sharpening, of image features such as boundaries, or contrast to make a graphic display more useful for display & analysis. This process does not increase the inherent information content in data. It includes gray level & contrast manipulation, noise reduction, edge crispening and sharpening, filtering, interpolation and magnification, pseudo coloring, and so on.

Image restoration:

It is concerned with filtering the observed image to minimize the effect of degradations. Effectiveness of image restoration depends on the extent and accuracy of the knowledge of degradation process as well as on filter design. Image restoration differs from image enhancement

in that the latter is concerned with more extraction or accentuation of image features.

Image compression:

It is concerned with minimizing the number of bits required to represent an image. Application of compression are in broadcast TV, remote sensing via satellite, military communication via aircraft, radar, teleconferencing, facsimile transmission, for educational & business documents, medical images that arise in computer tomography, magnetic resonance imaging and digital radiology, motion, pictures, satellite images, weather maps, geological surveys and so on.

- Text compression – CCITT GROUP3 & GROUP4
- Still image compression – JPEG
- Video image compression - MPEG

II. LITERATURE SURVEY

[1]Automatic detection and recognition of optic disk with maker-controlled watershed segmentation and mathematical morphology in color retinal images.

Optic disk (OD) detection and recognition is an important stage for developing automatic screening applications of diabetic retinopathy disease in color retinal image. However, the retinal image has a low resolution and was influenced by salt-and-paper noise. Therefore, a retinal image needs a preprocessing procedure (i.e., color image normalization, image enhancement and noise removal) prior to the use of the retinal images. Afterward, a combination of a maker-controlled watershed segmentation and mathematical morphology exiting that was applied to detect of OD. These two methods have complementary drawbacks and advantages, and this is the motivation for the hybrid method presented. These modifications enable the proposed methods to become more robust and accurate to detection of the OD regions. The methods were evaluated by applying to two-color retinal dataset [local dataset in Thailand and a public available diabetic retinopathy database (STARE)]. Although the retinal images in this paper are fairly low, the results showed the proposed method has the performance of the OD detection about 99.33% on 300 images from the local dataset and 95.06% of 81 images from the STARE dataset, taking an average computational time of 3.4 s per image. These results show effectiveness in both detections of the OD regions and boundary.

[2]Fusion of entropy-based thresholding and active contour model for detection of exudate and optic disc in color fundus images.

This paper proposes an efficient and accurate exudate and optic disc (OD) region segmentation methodology. Exudate, an inflammation that occurs in diabetic retinopathy, must be localized for diabetic retinopathy diagnosis. Similarly, the OD region must be inspected for changes in the macular area. Two methods are proposed for locating exudate and the OD region in color fundus images, respectively. The algorithms are then combined to build a single exudate and OD region segmentation algorithm. The methodology uses color normalization to the green channel color space, an intermediate pre-processing step, and a region segmentation step, where active-contour and entropy-based thresholding techniques are applied for segmenting an image to extract exudate and OD. The proposed method is tested on the MESSIDORe, e-ophtha, DIARETDB1, STARE, Pattern Recognition Lab (CS5), and local databases. The segmented images are compared with ground truth images manually generated by a clinician. The segmentation accuracy is found to be 98%. The algorithm successfully delineates the region of interest from the background.

[3] A clustering approach for exudates detection in screening of diabetic retinopathy.

Diabetic Retinopathy (DR) is an extensively spread retina disease which is the outcome of long term or uncontrolled

diabetes on the retina. Exudates are prominent sign of DR which is the crucial cause of loss of sight in patients suffering with diabetes. Early diagnosis of the disease through automated screening and regular treatment has proven helpful in preventing the spread of disease and irreparable visual impairment. This paper proposes a method using K-means clustering and morphological image processing for detection of exudates on low-contrast retinal images. The publicly available retinal images of DIARETDB1 database are used as the input samples for testing the algorithm. The exudates obtained using proposed algorithm are verified by comparing with hand-drawn ground truths images available along with DIARETDB1 database. The sensitivity and specificity of the algorithm obtained for the database is 88.34% and 99.27% respectively.

[4] Diabetic retinal exudates detection using machine learning techniques.

Diabetic Retinopathy (DR) is an eye filled illness caused by the complication of polygenic disease and that is to be detected accurately for timely treatment. As polygenic disease progresses, the vision of a patient could begin to deteriorate and leads to blindness. In this proposed work, the presence or absence of retinal exudates are detected using machine learning (ML) techniques. To detect the presence of exudates features like Mean, Standard deviation, Centroid and Edge Strength are extracted from Luv color space after segmenting the Retinal image. A total of 100 images were used, out of which 80 images were used for training and 20 images were used for testing. The classification task carried out with classifiers like Naive bayes (NB), Multilayer Perceptron (MLP) and Extreme Learning Machine (ELM). Experimental results shows that the model built using Extreme Learning Machine outperforms other two models and effectively detects the presence of exudates in retinal images

[5] Hard exudates detection method based on background estimation.

Hard exudates (HEs) are one kind of the most important symptoms of Diabetic Retinopathy (DR). A new method based on background-estimation for hard exudates detection is presented. Firstly, through background-estimation, foreground map containing all bright objects is acquired. We use the edge information based on Kirsch operator to obtain HE candidates, and then we remove the optic disc. Finally, the shape features, histogram statistic features and phase features of the HE candidates are extracted. We use the SVM classifier to acquire the accurate extraction of HEs. The proposed method has been demonstrated on the public databases of DIARETDB1 and HEI-MED. The experiment results show that the method's sensitivity is 97.3 % and the specificity is 90 % at the image level, and the mean sensitivity is 84.6 % and the mean predictive value is 94.4 % at the lesion level.

III. EXISTING SYSTEM

In existing, they proposed a novel method to detect exudates lesions in color retinal images by using a morphology mean shift algorithm. The method starts with a normalization of the retinal image, contrast enhancement, noise removal, and the localization of the OD. Then, a coarse segmentation method by using mean shift provides a set of exudates and non-exudates candidates. Finally, a model using the mathematical morphology algorithm (MMA) procedure is applied in order to keep only exudates pixels.

DISADVANTAGES OF EXISTING SYSTEM

- Existing method, only proposed for exudates lesions detection.
- It didn't making focus the other retinal lesions detection i.e. micro aneurysms and hemorrhages.

IV. PROPOSED SYSTEM

The proposed method comprises five steps,

- First obtaining the image from gallery;
- Second, the input image is preprocessed via normalization, contrast enhancement, noise removal and optic disc removal. The optic disc (OD) is automatically detected, to discard this area from the lesion detection.
- Third, candidate regions corresponding to potential lesions are identified in the preprocessed image, based on color segmentation, thresholding and morphological model.
- Fourth, feature extraction such as color and texture features are extracted from segmented image.
- Finally, the classification process is done over the features of segmented lesions. The main novelty here is the adoption of K-nearest neighbour classifier. Thus we classify the three type of disease in retina i.e. micro aneurysms, hemorrhages and exudates. The results obtained from the classifier are compared in terms of accuracy, sensitivity and specificity.

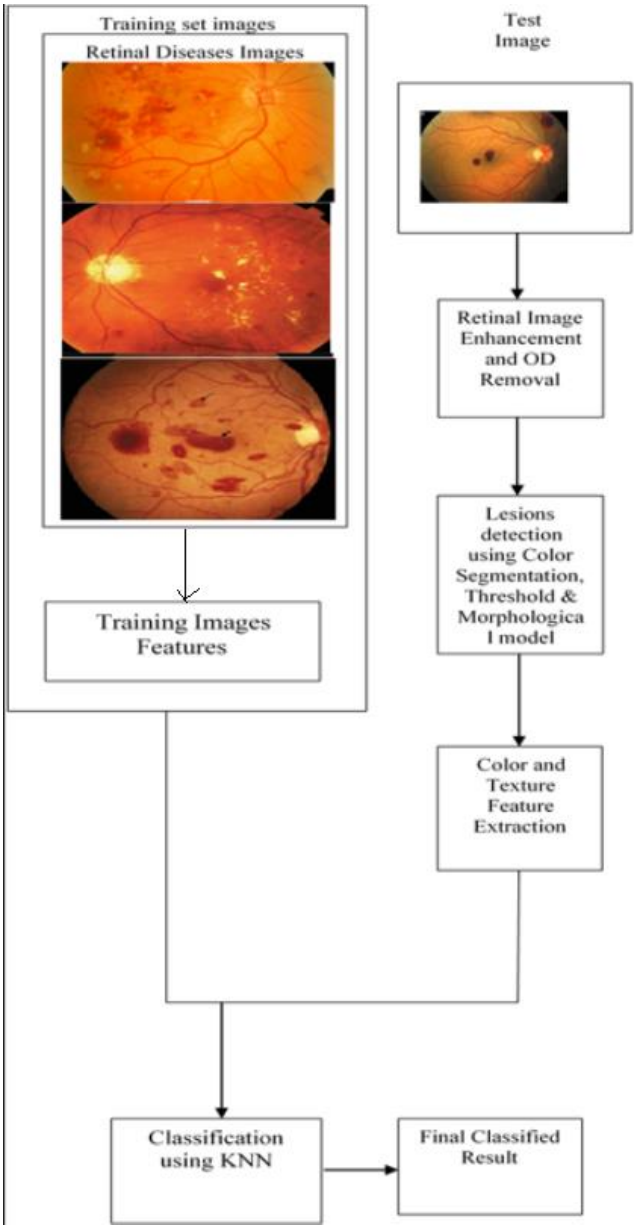


Figure.1 Proposed System Architecture

ADVANTAGES OF PROPOSED SYSTEM

- The obtained results demonstrate that using color and texture for retina images provides useful features for retinal disease screening.
- The rate of classification accuracy is high.The processing time is less

V. SYSTEM IMPLEMENTATION

MODULES:

- Image Acquisition
- Retinal Image Enhancement
- Retinal Lesions Detection
- Feature Extraction
- Classification

MODULE DESCRIPTION:

Image Acquisition:

- Image acquisition in image processing can be broadly defined as the action of retrieving an image from some source, usually a hardware-based source, so it can be passed through whatever processes need to occur afterward.
- Performing image acquisition in image processing is always the first step in the workflow sequence because, without an image, no processing is possible. The image that is acquired is completely unprocessed and is the result of whatever hardware was used to generate it, which can be very important in some fields to have a consistent baseline from which to work.
- Test images are acquires from database.

Retinal Image Enhancement:

- The aim of pre-processing is an improvement of the image data that normalize the image, suppresses unwanted distortions, enhances some image features and removal of OD important for further processing.
- We are applying multiscale image decomposition, illumination adjustment (gamma correction) for retinal image normalization and adaptive histogram equalization (AHE) process for contrast enhancement.
- To reduce the noise by median filtering applied on the enhanced image without reducing the sharpness of the retinal image.
- Finally, opening and closing function is used for removal of optic disc.
- The output achieved after this stage is an image with a normalized luminosity, enhanced contrast, reduced noise and removed OD.

Retinal Lesions Detection:

- The goal of segmentation is to simplify or change the representation of an image into something that is more meaningful and easier to analyze. The YCbCr color segmentation is selected due to its invariant properties.
- The YCbCr color space is very important and attractive color model for image processing applications because it represents colors similarly how the human eye senses colors. The YCbCr color model represents each color with two components: Luminance (Y), Chrominance (Cb, Cr).
- After the color segmentation, thresholding and morphological operation is used for lesions detection.

Thresholding Method:

- Thresholding makes it possible to highlight pixels in an image.

- Thresholding can be applied to gray scale images or color images. In this discussion lab color space model images are used.
- In Thresholding a pixel intensity value is adjusted, by taking the given value as reference the low intensity pixels will become zero and rest of the pixels will become 1.
- The result of the Thresholding is a binary image containing black and white pixels.

Morphological Operation:

- Morphology is a technique for extracting the information from an image which is representation and description of region shape.
- In this paper morphological operations are used in post processing mainly as a filter.
- Its fundamental operations are Boundary pixels and low frequency pixels are eliminated from image.
- **Erosion**: it shrinks objects in the binary image
- **Dilation**: grows or thickens the objects in binary image

Feature Extraction:

- Feature extraction plays an important role for classification of retinal lesions types.
- In our work, considers statistical color feature and texture features for classification.
- In statistical color based, color moments such as mean and standard deviation are extracted for each channel of lesions detected image.
- In texture features, GLCM based energy, contrast, correlation and homogeneity features are extracted for detected lesions image.

Classification:

- The classification process is done over the extracted features.
- The main novelty here is the adoption of K-nearest neighbour.
- KNN is applied over the features and the classification is done.

VI. RESULTS

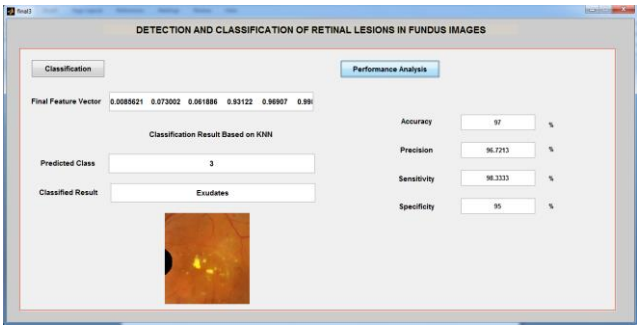


Figure.2 EXUDATES

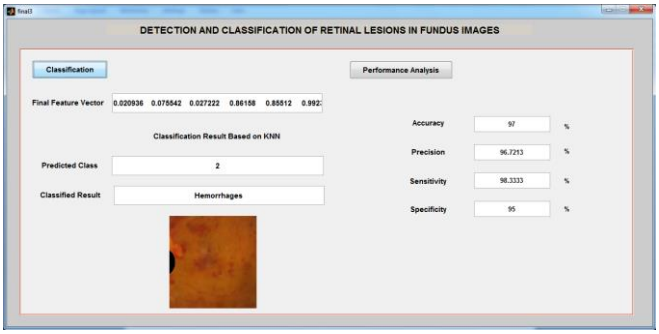


Figure.3
HEMORRHAGES

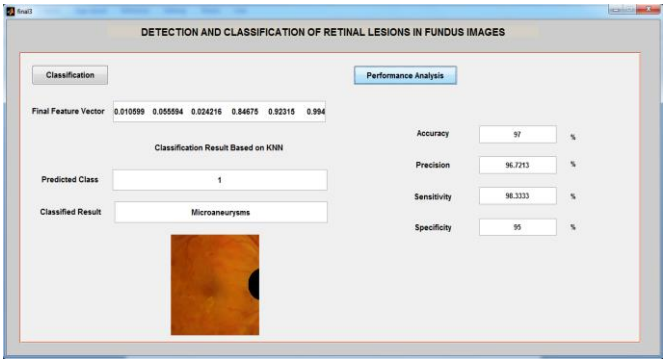


Figure.4 .MICRO ANEURYSUMS

VII. CONCLUSION

The present work discusses a novel algorithm to detect and classify the retinal lesions by using YCbCr color segmentation, thresholding, morphological and k-nearest neighbor algorithms. In this place, two more algorithms are integrated for lesions detection and color

and texture features are extracted to effectively lesions classification based on machine learning model i.e. KNN. Our novel work increases accuracy values which are 97 % for lesions classification. The results of the current study have proved prominent success in detecting and classifying retinal lesions.

VIII. FUTURE ENHANCEMENTS

In proposed system, we implement the diabetic retinopathy detection based on retinal lesions detection and classification.In future we will propose the diabetic macular edema detection based on exudate.it is used for early detection of blindness.

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