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An Efficiency Analysis for Detection of Exudates in Color Images using Clustering Algorithms

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Abstract: This research work enhances the process of exudates detection using two algorithms. The objective of system is to increase the performance and reduces the time factor while extracting the features from the color images. The preprocessed color retinal images are segmented using K-Means Clustering technique. The segmented images establish a dataset of regions. To classify these segmented regions into Exudates and Non-Exudates, a set of features based on color and texture are extracted. The contrast adaptive histogram equalization is used for preprocessing stage and Fuzzy C-Means (FCM) and k-Means clustering algorithms are applied to segment the exudates in abnormal input images. A set of features such as the standard deviation, mean, energy, entropy and homogeneity of the segmented regions are extracted and fed as inputs into random forest (RF) classification to discriminate between the normal and pathological image. At finally, calculate the time factor and analyzing the performances of proposed approach.

Keywords: Exudates detection, K-Means, fuzzy c-Means, variance, Entrophy.

I. INTRODUCTION

The retina is the inner and most important layer of the eye. It is composed of several important anatomical structures which can indicate various diseases. Cardiovascular disease such as stroke and myocardial infarction can be identified from retinal blood vessels. If the exudates extend into the macular area, vision loss can occur. A large number of methods for automatic exudates detection have been published. T.Akila , G. Kavitha propose an automatic exudates detection algorithms, C. Sinthanayothin et al. [1]propose an automated system of detection of diabeticretinopathy using recursive region growing segmentation(RRGS). A. Osarah et al. [2, 3] use fuzzy c-means (FCM) clustering to segment color retinal images, then a neural network and support vector machines (SVMs) are used to separate exudate and non-exudate areas. Morphological reconstruction techniques to detect the contours of exudates are proposed by T. Walter et al. [4]. D. Usher et al. [5] X. Zhang and OChutatape [6] use local contrast enhancement and FCM to segment candidate bright lesion areas.

II. METHODOLOGY

Exudates detection was performed using the traditional methods of mathematical morphology, FCM, a combination of FCM and mathematical morphology.

A. Preprocessing:

Colour fundus images often show important lighting variation, poor contrast and noise. In order to reduce these imperfections and generate images more suitable for extracting the pixel features in the classification process, a preprocessing comprising the following step is applied.

a. RGB TO GREY SCALE CONVERSION
b. Apply filtering technique
c. Draw Histogram Equalization.

B. Rgb To Gray Scale Conversion:

The input retina image is converted to gray scale.

C. Filtering Technique:

There many filtering techniques are available. We have use the Bayesian filter to the input image. It removes the noises from the input image.

D. Draw Histogram:

The contrast limited adaptive histogram equalization is applied on the filtered I-component of the image. From the histogram, calculate mean, energy, entropy value.

$$CONTRAST = \sum_{n=0}^{G-1} n^2 \{\sum_{i=1}^{G}\sum_{j=1}^{G} P(i,j)\}, \quad |i-j| = n \tag{1}$$

HOMOGENEITY:

$$= \sum_{i=0}^{G-1}\sum_{j=0}^{G-1} \frac{1}{1+(i-j)^2} P(i,j) \tag{2}$$

$$ENTROPY = -\sum_{i=0}^{G-1}\sum_{j=0}^{G-1} P(i,j) \times log(P(i,j)) \tag{3}$$

$$VARIANCE = \sum_{i=0}^{G-1}\sum_{i=0}^{G-1} (i-\mu)^2 P(i,j) \tag{4}$$

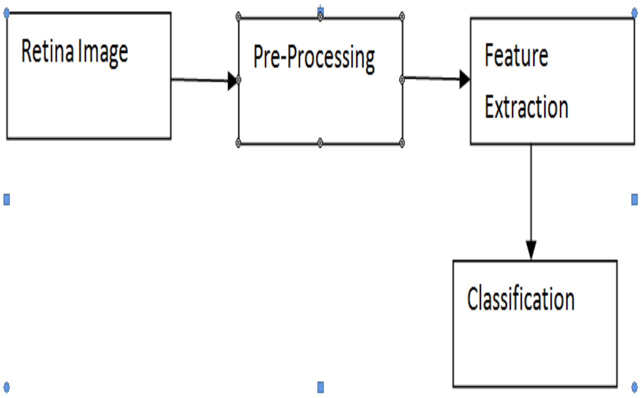

Figure.1 Black diagram for Exudates Detection

III. FEATURE EXTRACTION

To classify the localized segmented image into exudates and Non-exudates, a number of features based on colour and texture are extracted using Gray Level Co-occurrence Matrix (GLCM) . GLCM is a tabulation of how often different combination of pixel brightness values occur in a pixel pair in an image. Each element (i, j) in GLCM specifies the number of times that the pixel with value i occurred horizontally adjacent to a pixel with value j. The resulting matrix was analyzed and based on the existing information, the feature vectors are formed .The contrast, entropy, variance are calculated using the following formulae:

IV. CLASSIFICATION

For the naive Bayesian classifier are proposed to distinguish exudates pixels from non-exudate pixels by using a Naive Bayesian classifier. It contained six features:

a. The pixel's intensity after preprocessing,
b. The standard deviation of the preprocessed intensities in a window around the pixel,
c. The pixel hue,
d. The number of edge pixels in a window around the pixel,
e. The ratio between the size of the pixel's intensity cluster and the optic disc, and 6. DoG4.

V. CALCULATE TIME COMPLEXITY

The time complexity for each algorithm is analyzed and summarized in Table 4. In the testing phase, the time complexity for the traditional algorithm approach is higher than that for the prposed approach. However, for the propoosed approaches, a training phase is also required so extra computational costs must be included. In the case of K-means, for example, the training time is related to the number of related neighboring points, which depend on the dataset and on the non-linear mapping from input space to the feature space. The time complexity of the proposed classifier is equal to the time complexity of the nearest neighbor classifier if the numbers of similarities are equal to number of training points.

VI. RESULTS AND DISCUSSION

The following tables are representing the result of our implementation of proposed research work. It yields a higher performance as compared to the existing technology.

Features	Normal Image	Abnormal Image	Differences
Entrophy	0.010832	0.010367	0.000104
Mean	0.718865	0.725455	0.00659
Variance	1	0.9823	0.0277
Homogeneity	0.23578	0.34510	0.10932

Figure 2.Feature Extraction and Time Complexity

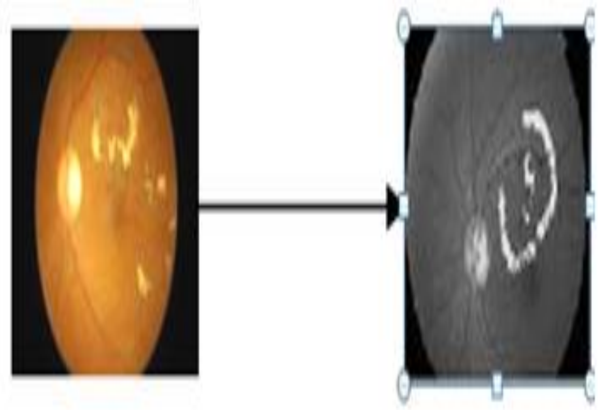

Figure 3. Exudates Detection from Original Image

VII. CONCLUSION

The universal aim of our work is to develop an automatic exudates detection system to provide decision support and reduce ophthalmologists' workloads. The feature extraction again needs the proper thresholding values. The basic requirement in template matching is that we need both normal and abnormal images. The orientation angle, lighting of both reference and the abnormal image should be same otherwise it would give wrong identification of presence of exudates.

VIII. REFERENCES

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