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Detection of Exudates in Diabetic Retinopathy images Using Boosting based Algorithms

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Abstract

Diabetic retinopathy is a leading cause of vision loss in developed countries. Regular diabetic retinal eye screenings are needed to detect early signs of retinopathy, so that appropriate treatments can be rendered to prevent blindness. Digital imaging is becoming available as a means of screening for diabetic retinopathy. However, with the large number of patients undergoing screenings, medical professionals require a tremendous amount of time and effort in order to analyse and diagnose the fundus photo-graphs, the treatment is done on a digital image, to obtain results as complex as recognizing patterns or as simple as enhancing con-tours, may involve filtering, transformations of gray levels, based on histogram processing, describing, between others. The design of a teaching tool to facilitate image processing, allowing access to each of the steps involved in the system, ensure the achievement of good results supported the implementation of parameterized and interactive techniques supported. In the classification of pathological images is the marking of the images to see them done after the pre-processing, which are marked to be admitted to the boosting algorithm, is used mainly variant gentleBoost, and supported in the basic concepts of image processing.

Keywords:_Pre-procesamiento, Adaboost, ROC, Sensibilidad._

I. Introduction

The optical system of the human eye and especially the retina have, since ancient times, attracted the attention of researchers who were study instruments and correct the defects of ocular optics. Diabetic Retinopathy (RD) is an ocular complication of diabetes mellitus caused by the displacement of the blood vessels supplying the eye. One of the manifestations that RD presents is the presence of exudates, which appear as very luminous objects. , main characteristic (yellowish color) due to the reflection of blood proteins. This article presents the development of the techniques to be used, which consists in the classification of the pathological images obtained from the IMAGRET database, the signaling of the images is carried out, and then due pre-processing is carried out at the marked images, then they will be marked in order to be entered, to the Boosting algorithms, mainly the gentleBoost variant is used.

The evaluation of fundus images is a basic carrier of information, since in addition to being considered a natural window to the human brain vascular system, it contains information of unmatched value on the state of the anatomical structures of the eye.

This work presents an analysis of fundus images with Diabetic Retinopathy, particularly the presence of exudates, this lesion is one of the first symptoms

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of DR, its main characteristic is based on the yellowish color it presents. The location of the optic disc in the retina is essential for the detection of exudates, because the optic disc has similar characteristics in terms of color and contrast, with the early detection of this manifestation of the pathology, the disease status.

Processing techniques are intended to enhance or enhance image properties to facilitate machine vision operations, such as pre-processing and automatic image interpretation. The article will be developed by focusing on these two techniques. Health professionals specialized in the subject require the characterization of these images, which will serve as support in their diagnosis.

Currently there are many proposals where an attempt is made to classify exudates as the first indicator of the development of diabetic retinopathy. The use of convolutional networks are being used with good results, achieving a sensitivity greater than 0.90 and specificity in the range of 0.95 [1].

II. METHODOLOGY AND DATA

Digital image processing has a wide range of applications in different sectors, ranging from academia and engineering to industry and medicine, where obtaining information from images allows decision-making based on pattern models established from them. The proposed method can be divided into two stages: the Pre-processing phase, and the training and classifier test phase.

The pre-processing stage is based on a set of heuristic procedures that have given satisfactory results. Heuristic techniques are a combination of procedures based on digital signal processing and other types of mathematical manipulations. This means that according to the problem addressed, a series of transformations are implemented, resulting in an image for a specific problem. These algorithms can be cataloged based on the claims of their transformations:

- ✓ Enhancement or contrast (enhancement)
- ✓ Smoothing or noise reduction (denoising)
- ✓ Edge detection

For the Pre-processing stage, the images from the IMAGRET Database will be used.

Enhancement or contrast (enhancement)

- Lighting is uniform
- The gain between the input light and the image is linear
- Contrast indicates the difference in intensity between light and dark parts
- An intensity histogram can be used to observe the contrast of an image

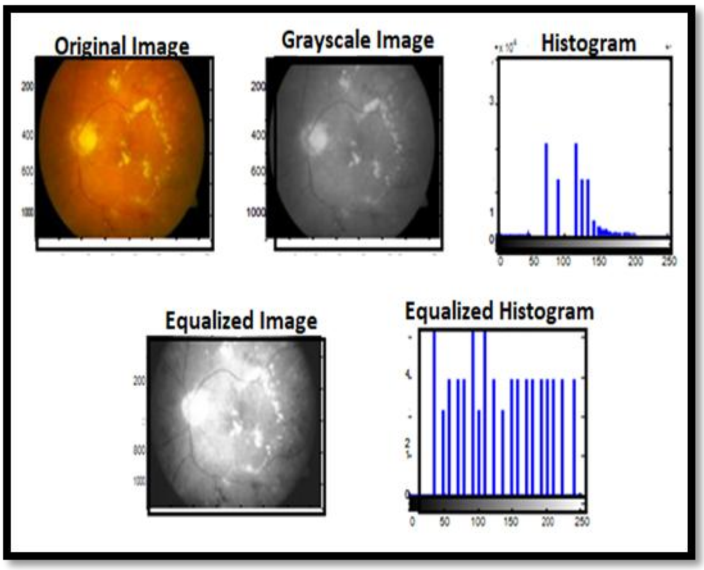

Fig 1: Contrast Increase

It can be seen that the original image has low contrasts because the intensity range is poorly distributed in the spectrum. In the histogram of the original image it is observed that it does not cover the entire possible range and therefore it is losing the high and low values, which could result in a good contrast. What was done is to expand the intensity values over the entire range, and in this way we improve the contrast of the image. This process is called contrast equalization.

Smoothing or noise reduction (denoising)

Isolated pixels that take different values from their neighbors due to:

- ✓ To the signal transmission médium.
- ✓ There are different types of algorithms that allow noise reduction.
- ✓ Median filter The pixels of the new image are generated by calculating the median of pixels of the neighborhood environment of the pixel corresponding to the source image. This type of filter is quite suitable when you have random noise.

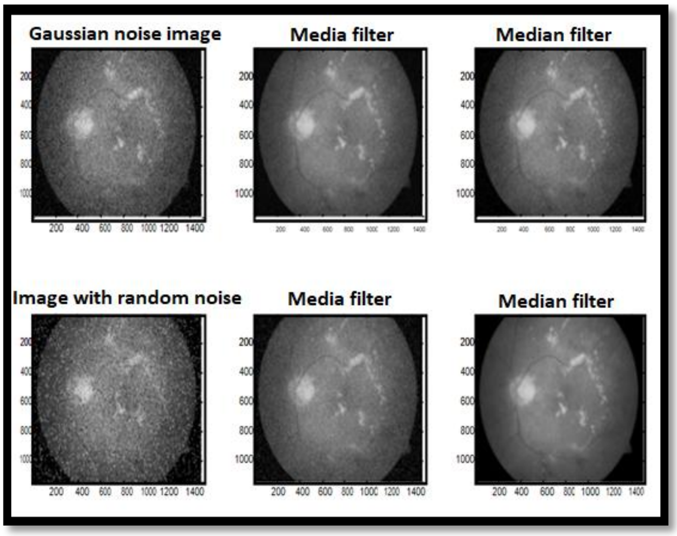

Fig 2: Noise reduction

In Figure. 2 it can be seen that the image treatment with random noise and median filter the resulting image is less blurred compared to a Gaussian noise.

Edge detection

- ✓ Highlight those pixels that have a different gray value than their neighbors.
- ✓ Edge detection operators usually deliver a large number of edges from which the image outline needs to be constructed

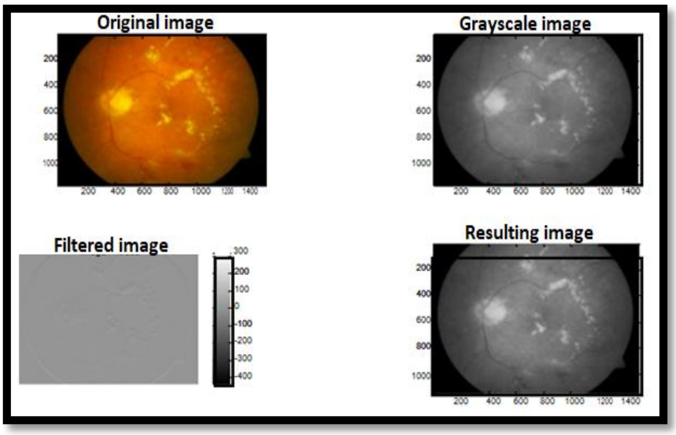

Fig 3: Edge detetion

In the images you can see how it is accentuated, the contours of the image applying a high pass filter we obtain the resulting image.

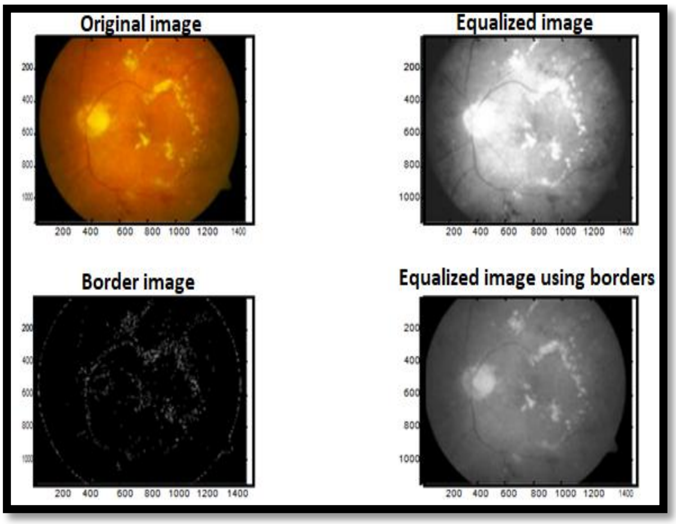

Fig 4: Enhance equalized images using borderimage

What is obtained with this algorithm, is that the gray levels are better distributed, but for this item we work using the edge image, which allows an improvement in the resulting images.

Introduction to Boosting

The grouping of several Classifiers, obtained using the same method, is a natural way to increase the precision, with respect to that obtained with the isolated use of said classifiers. One of the most popular methods to create these classifier groupings is Boosting, this method encompasses a whole family of methods, of which Adaboost is the best known variant.

The Adaboost algorithm is described below:

T= {ti} i=1,…N training set, each instance with a probability of being chosen to train the classifier
p (i) =1/N.

1.- In iteration K the set T is shown with replacement to obtain training data Tk, with a probability distribution of p (i).

2.- The fk classifier is created and tested with all available training data.
Let d (i)) = 1 if example i has been misclassified, or otherwise.

3.- Definimos:
Ek= Summation d (i) p (i) and Bk= (1-Ek)/Ek

4.- Update the weights for the iteration k+1:
P (i) = p (i) Bkd (i) / p (i) Bk d (i)

The exit from the system will be a weighted vote of all the Fx with weights Log (Bk)

1.- Obtaining the images from the project database ImageRet [2].

2.- The images are marked manually and we obtain a corresponding XML file for each image.

3.- We proceed with the execution of the scripts that will make it possible to execute the Adaboost algorithm. In these scripts, the following must be taken into account: the number of images to work, the place where the images are and their respective XML files, the dimensions of the images, the number of images used for training and testing the algorithm.

Marking of exudates

Fig 5: Obtaining the XML file, after marking

Fig 6: Obtaining the XML file and Image marked with the Annotation Tool with one of the sections where pathology exists.

III. RESULTS

Here is an example of classifying an image:

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Fig 7: Original fundus image

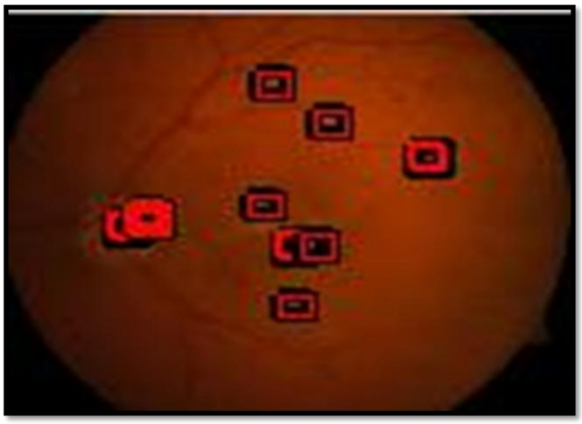

Fig 8: Resulting image thrown by the classifier

As can be seen, the regions where Exudates exist are those where there is a more intense color in yellow, and when the marking was made, only a few areas where exudates exist were considered as a test measure, so that the classifier can detect the remaining areas where there is more exudate.

Taking the visual analysis and comparing with the database, there are still areas where exudate exists and could not be detected.

Sensitivity.- It is the proportion of individuals with the disease that have a positive test.

VP/ VP+FN

In this way, sensitivity tells us how good a diagnostic test is to identify a disease, which is why it is also called a true positive rate.

In our case, the false negatives are the exudates that Boosting did not find and exist in the image.
Specificity.- is the proportion of healthy that has a negative test.

VN/VN+FP

In other words, the specificity values the usefulness of a test in order to identify the non-sick, it is also called the true negative rate.

In our case, the false positives are the exudates that Boosting marked and that do not appear in the image.

For an indicator to be useful it must have high sensitivity and specificity.

The area under the curve can be interpreted as the probability that the test classifies it correctly for a pair of individuals, one sick and the other healthy.
The results obtained in the present work showed a sensitivity of 49% and a specificity of 98% and the area obtained under the curve was 0.897.

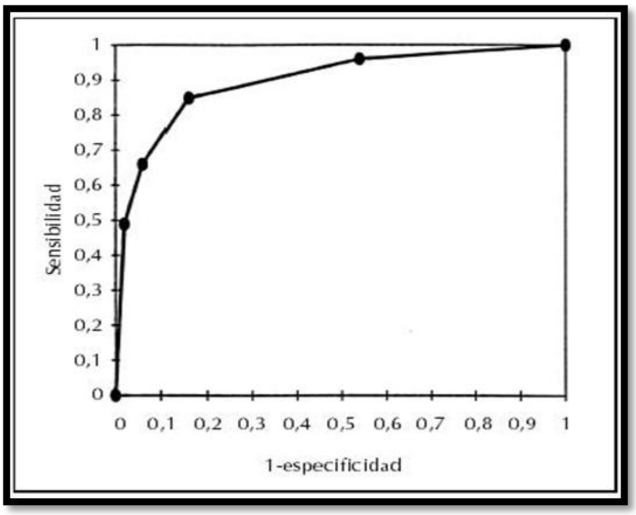

Fig 9: Curva ROC de las Prueba

IV. CONCLUSIONS

The development of the theme basically implements the elementary operations, and of great utility, which takes place in the treatment of images and enhances the importance of interaction with the user, in turn supports functions of contrast manipulation, noise reduction and edge detection. The grouping of several classifiers, obtained using the same method, is a natural way of increasing precision, with respect to that obtained with the isolated use of these classifiers. It is possible to conclude that with the use of the Boosting algorithm in the search for the marking of exudates in the images, excellent results are obtained.

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