International Journal of Recent Trends in Engineering & Research (IJRTER)
Conference on Electronics, Information and Communication Systems (CELICS'17)
Special Issue; March - 2017 [ISSN: 2455-1457]
DOI : 10.23883/IJRTER.CONF.20170331.016.MOASB

MULTICLASS SVM BASED RED LESION DETECTION AND GLAUCOMA DETECTION FOR DIABETIC PATIENT

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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 fundus image. Large number of people suffers from eye diseases in rural and semi urban areas all over the world. Current diagnosis of retinal diseases relies upon examining retinal fundus image. In this project, a novel method for automatic detection of red lesion and glaucoma in color retina images is described and validated.Red lesion is any abnormal damage or change in the tissue of an organism, usually caused by disease. Glaucoma is a neurodegenerative disorder of the optic nerve, which causes partial loss of vision. The main contribution of projects is a newest of dynamic shape and GLCM features. These features represent the evolution of the shape during image flooding and allow to discriminate between lesions and vessel segments. Multilevel SVM used for final validation of the proposed method. Different output parameters such as accuracy, sensitivity and specificity are measured. Finally the improved output parameters were obtained.

Key words – Red lesion, Glaucoma, Multi-level support vector machine, diabetic retinopathy, Healthy.

I. INTRODUCTION

Diabetic Retinopathy (DR) is a complication of diabetes that can lead to impairment of vision and even blindness. One out of three diabetic person presents signs of DR and one out of ten suffers from its most severe and vision threatening forms. DR can be managed using available treatments, which are effective if diagnosed early. Since DR is asymptomatic until late in the disease process, regular eye fundus examination is necessary to monitor any changes in the retina. In this paper, we proposed a method for the detection of red lesion and glaucoma. Glaucoma is the starting stage of the eye disease which will damage the optic nerve. This nerve damage is usually related to increased pressure in the eye. From the glaucoma only red lesion will be formed.

II. PROPOSED METHOD

Diabetic Retinopathy (DR) is a complication of diabetes that can lead to impairment of vision and even blindness. It is the most common cause of blindness in the working-age population. One out of three diabetic person presents signs of DR and one out of ten suffers from its most severe and vision threatening forms. DR can be managed using available treatments, which are effective if diagnosed early. Since DR is asymptomatic until late in the disease process, regular eye fundus examination is necessary to monitor any changes in the retina. In this paper, we proposed a method for the detection of red lesion and glaucoma. Glaucoma is the starting stage of the eye disease which will damage the optic nerve. This nerve damage is usually

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BLOCK DIAGRAM

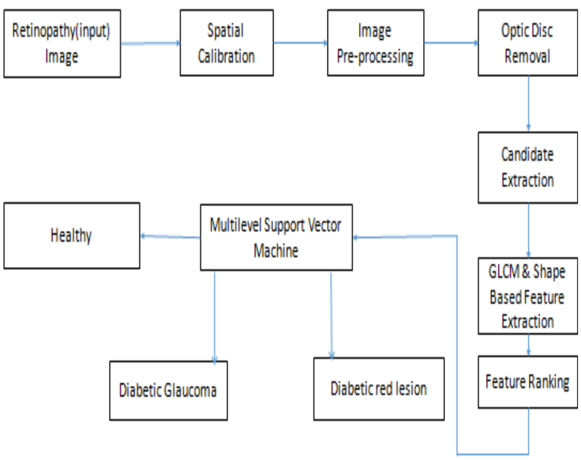

Fig 1 Block Diagram

A. Spatial Calibration

Spatial calibration is a tool that can convert automatically the pixel values to any other unit of measurement by multiplying the measures values by conversion. The set of operation which establish, under specified conditions, the relationship between values indicated by a measuring instrument or system and the corresponding known values of the measurement. Three size parameter are used in our method.

B. Image Preprocessing

Imaging preprocessing is processing of image using mathematical operations by using any form of signal processing for which the input is an image, a series of images, or video, such as a photograph or video frame. It is an improvement of the image data that suppresses unwanted distortion. The output of the image processing may be either an image or asset of characteristics or parameter related to the image. Most image processing techniques involve treating the image as a two-dimensional signal and apply standard signal-processing techniques to it. There are some techniques which is used in the image preprocessing which is below:

1) Illumination Equalization
2) De-Noising
3) Adaptive Equalization
4) Color Normalization

1)Illumination Equalization

It is produced in vignetting effect. Vignetting effect means added by noise in lightening process that noise is removed by de-noising technique. To overcome the vignetting effect, the illumination equalization method is used:

$$I_{ie} = I + u - I * h_{M1}$$

A large mean filter (h_{M1}) of diameter d_1 is applied to each color component of the original image I in order to estimate its illumination. Then, the resulting color image is subtracted from the original one to correct for potential shade variations. Finally, the average intensity of the original channel is added to keep the same color range as in the original image.

2)De-Noising:

De-noising is important image processing task, both as a process itself, and as a component in the other processes. There is many ways to denoise an image or a set of data exists. The main properties of a good image denoising model is that it will remove noise while preserving edges. Traditionally linear models have been used. One big advantage of using linear noise removal models is the speed, but a drawback of the linear models is that they are not able to preserve edges in a good manner, edges, which are recognized as discontinuities in the image. Nonlinear models on the other hand can handle edge in a much better way than linear models. This filter is very good at preserving

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edges, but smoothly varying regions in the input image.

3)Adaptive Contrast Equalization

An adaptive contrast equalizer is an equalizer that automatically adapts to time-varying properties of the communication channel. It is frequently used with coherent modulations such as phase shift keying, mitigating the effects of multipath propagation and Doppler spreading. Equalizer is the reversal of distortion incurred by a signal transmitted through a channel. It is used to render the frequency response. Input image and de-noising image added to compared and produced the output image. The contrast drift is approximated using the local standard deviation computed for each pixel in a neighborhood of diameter d_1, for each color channel. Areas with low standard deviation indicate either low contrast or smooth background. To enhance low contrast areas, we sharpen the details in these specific regions using for each color channel separately:

$$I_{ce} = I_{dn} + 1/I_{std} (I_{dn}* (1-h_{M3}))$$

4)Color Normalization

Color normalization is a topic in computer vision concerned with artificial color vision and object recognition. In general, the distribution of color values in an image depends on the illumination, which may vary depending on lighting condition, cameras, and other factors. Color normalization allows for object recognition techniques based on color to compensate for these variation. In color normalization, the main concepts is the color constancy and it is a feature of the human internal model of perception, which provides humans with the ability to assign a relatively constant color to object even under different illumination condition. This is helpful for object recognition as well as identification of light sources in an environment.

C. Optic Disc Removal

The optic disc (OD) is a significant source of false positives in red lesion detection, therefore its removal is a necessary steps. Starting from the preprocessed image, we first use an entropy-based approach to estimate the location of the OD's center. Basically, the OD is located in a higher intensity region where the vessels have maximal directional entropy. By using the entropy method can detect the problem and brightness will be increased. A subsequent optimization step then estimates the OD's radius and refines its position. This consists in convolving a multi-scalering-shaped matched filter to the image in a sub-ROI centered on the first estimation of the OD's center, of radius equal to a third of the ROI's radius. The radius and position of the matched filter that minimizes the convolution are selected as the OD's final radius and center position.

D. Candidate Extraction

Since blood vessel and dark lesions have the highest contrast in the green channel, the latter is extracted from the preprocessed image. The red and blue channels are used later to extract color features. In the green channel, MAs and HEs appear as structure with local minimal intensity. A regional minimum is a group of connected pixels of constant intensity, such that all the adjacent pixels have strictly higher intensity and this method is highly sensitive to noise. Depending on the smoothness of the image, the number of regional minima can thus be very large to overcome the limitation, we adopt the dynamics transformation which rates regional minimal according to their local contrast. Noisy minima usually have lower contrast than red lesion. Contrast and

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illumination equalization gain importance at this point. Without these preprocessing steps, global contrast and intensity thresholding would be difficult to achieve.

E. Gray Level Co-Occurrence Matrix

The Gray-Level Co-occurrence Matrix considers the relationship between two neighbor pixels, the first pixel is known as a reference and the second is known as a neighbor pixel. The GLCM is a square matrix with dimension. A co-occurrence matrix is a two dimensional array in which both rows and columns represent a set of possible image values. The Gray Level Co-occurrence Matrix (GLCM) method is used for extracting four Statistical Texture Parameters i.e., Entropy, Inverse Difference Moment, Angular Second Moment and Correlation. By extracting the features of an image by GLCM approach, the image compression time can be greatly reduced in the process of converting RGB to Gray level image when compared to other DWT Techniques, but however DWT is versatile method of compressing video as a whole. These features are useful in motion estimation of videos and in real time pattern recognition applications like Military & Medical Applications. A statistical method of examining texture that considers the spatial relationship of pixels is the gray-level co-occurrence matrix (GLCM), also known as the gray-level spatial dependence matrix. The GLCM functions characterize the texture of an image by calculating how often pairs of pixel with specific values and in a specified spatial relationship occur in an image, creating a GLCM, and then extracting statistical measures from this matrix. GLCM is a tabulation of how often different combinations of pixel brightness values occurred in an image. GLCM contain the information about the positions of pixel having similar gray level values. GLCM calculation unit receive pairs of gray level values as input calculation unit consists of the different combination of gray values like a0b1, a2b3, a10,b21. This gives the deviation present in the image when compared with original image by predictive image.

F. Shape Based Feature Extraction

Feature extraction involves reducing the amount of resources required to describe a large set of data. When performing analysis of complex data one of the major problems stems from the number of variables involved. Variables generally requires a large amount of memory and computation power, also it may cause a classification algorithm to overfit to training samples and generalize poorly to new samples. Feature extraction is a general term for methods of constructing combinations of the variables to get around these problems while still describing the data with sufficient accuracy. Feature extraction starts from an initial set of measured data and builds derived values (features) intended to be informative and non-redundant, facilitating the subsequent learning and generalization steps, and in some cases leading to better human interpretations. Feature extraction is related to dimensionality reduction.

G. Feature Ranking

Entropy:

Entropy (usual symbol S) is a measure of the number of microscopic configurations Ω that a thermodynamic system can have when in a state as specified by certain macroscopic variables. Specifically, assuming that each of the microscopic configurations is equally probable, the entropy of the system is the natural logarithm of that number of configurations, multiplied by the Boltzmann constant k_B (which provides

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consistency with the original thermodynamic concept of entropy discussed below, and gives entropy the dimension of energy divided by temperature). Formally, Entropy shows the amount of information of the image that is needed for the image compression. Entropy measures the loss of information or message in a transmitted signal and also measures the image information.

Standard Deviation:

Standard deviation (SD, also represented by the Greek letter sigma σ or the Latin letter s) is a measure that is used to quantify the amount of variation or dispersion of a set of data values. A low standard deviation indicates that the data points tend to be close to the mean (also called the expected value) of the set, while a high standard deviation indicates that the data points are spread out over a wider range of values. The standard deviation of a random variable, statistical population, data set, or probability distribution is the square root of its variance. It is algebraically simpler, though in practice less robust, than the average absolute deviation.

Mean:

In probability and statistics, mean and expected value are used synonymously to refer to one measure of the central tendency either of a probability distribution or of the random variable characterized by that distribution. In the case of a discrete probability distribution of a random variable X, the mean is equal to the sum over every possible value weighted by the probability of that value. That is, it is computed by taking the product of each possible value x of X and its probability P(x), and then adding all these products together.

Skewness:

Skewness is a measure of the asymmetry of the probability distribution of a real-valued random variable about its mean. The skewness value can be positive or negative, or even undefined. The qualitative interpretation of the skew is complicated. For a unimodal distribution, negative skew indicates that the tail on the left side of the probability density function is longer or fatter than the right side – it does not distinguish these two kinds of shape. Conversely, positive skew indicates that the tail on the right side is longer or fatter than the left side. In cases where one tail is long but the other tail is fat, skewness does not obey a simple rule. Importantly, the skewness does not determine the relationship of mean and median.

H. Multi-Level Support Vector Machine

Multi-level support vector machine is finding the margins, the only samples that matches our pattern are the one's that are close to the hyper plane and other samples have been found irrelevant to our pattern elsewhere. Samples that selected with SVM as support vectors are marked with a circle around them. As seen, only the places that are marked are specified to match favoured results the other conclusions in this case have no value in defining vectors. Meanwhile, the rest of the data are located in different places and the majority of data are pointing elsewhere. It is obvious that this discussion with the existence of the kernel brought to this conclusion that when this result is sought a different environment it could have separable linear outcomes. Artificial dataset and final decision of the SVM. The omittance of outlier brings up this crucial point that one of the pre-processes happens before classifications. As it have been pointed out in the only results that are close to favoured margin are considered relevant –regardless of the data and the places of their positioning in confirming our favoured results. The outcome although vary but they contain useful details that helps in classification of so called data. To get resolve hidden information embedded in the data we use MLSVM.

III. RESULT

The sensitivity tells us how likely the test is come back positive in someone who has the characteristics. This is calculated as TP/(TP+FN). It is also called the true positive rate, the recall, or probability of detection in some fields and to measure the proportion of positive that are correctly identified. The specificity tells us how likely the test is to come back negative in someone who has the characteristics. This is calculated as TN/(TN+FP).It is also called the true negative rate and to measure the proportion of negatives that are correctly identified that are correctly identified.

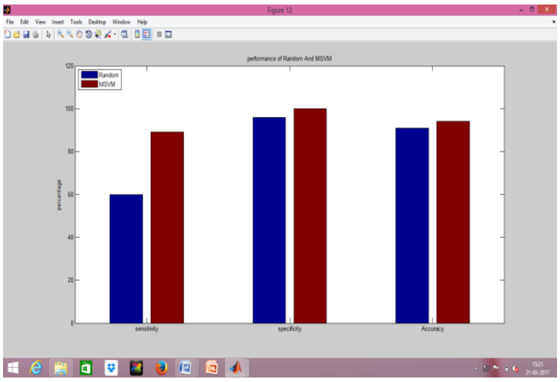

Fig 2 Dynamic shape feature vs. Multi-level support vector machine

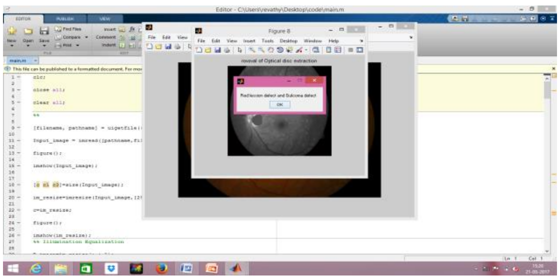

Fig 3 Red lesion and glaucoma detection

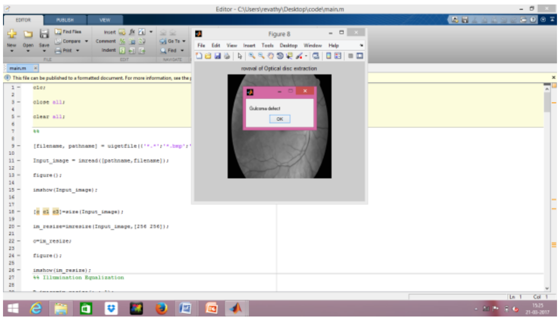

Fig 4 Glaucoma detection

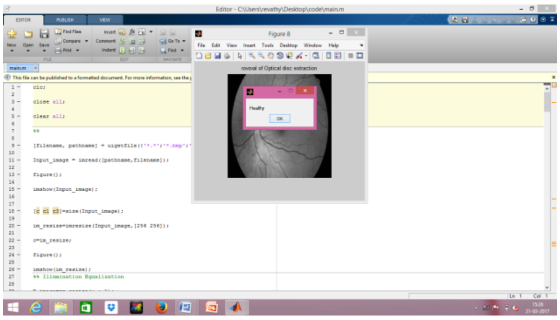

Fig 5 Healthy detected

IV. CONCLUSION

To overcome the problem of identifying the patient eye diseases by using novel lesion detection method based on a new set of shape features. Here we use two different features to overcome the drawbacks of existing method and that is GLCM and Shape based feature extraction. In existing method only MA, HE were detected, but this novel technique which is used to find red lesion in the eye.

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