Mathwork Utilization for Effective Detection of Diabetic Retinopathy

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Abstract - Diabetes is a rapidly increasing worldwide problem which is characterized by defective metabolism of glucose that causes long term dysfunction and failure of various organs . The most common complication of diabetes is diabetic retinopathy (DR) , which is one of the primary cause of blindness and visual impairment in adults. The rapid increase of diabetes pushes the limits of the current DR screening capabilities for which the digital imaging of the eye fundus (retinal imaging) and automatic or semi –automatic image analysis algorithms provide a potential solution. In this work, the use of colour in the detection of diabetic retinopathy is statistically studied using a supervised algorithm based on one-class classification and Gaussian mixture model estimation .The presented algorithm distinguishes a certain diabetic lesion type from all other possible objects in eye fundus images by only estimating the probability density function of that algorithm combines manual annotations of several experts for which the best practice were experimentally selected. By assessing the algorithm `s performance while conducting experiments with the colour space selection, both illuminance and colour correction ,and background class information, the use of colour in the detection of diabetic retinopathy was quantitatively evaluated .

I. INTRODUCTION

Diabetes, which can be characterized as a chronic increase of glucose in the blood , has become one of the most rapidly increasing health threats world wide. There are an estimated 150 to 200 million people diagnosed with diabetes, of which approximately 50 million within India alone. Moreover a large number of people remain undiagnosed. In Karnataka, which has a population of around 1.8million, there are 280000people under diabetes care of which insulin production in the pancreas is permanently damaged for 40,000 people (type 1 diabetes),and resistance to insulin is increased for 240,000 people (type 2diabetes). In addition the current estimates predicts that 200,000 undiagnosed patients and that the number of people receiving diabetes care wills double every 12 years. These alarming facts promote prevention strategies and screening over a large population sine proper and early treatment of diabetes is cost effective . Digital imaging technology has developed into a versatile non-invasive measurement tool which enables a wealth of applications also in medical sciences . Imaging the eye funds with modern techniques is a current practice in many eye clinics , and it is becoming even more important as the expected lifetime and the cost of health care increase. Since the retina is vulnerable to micro vascular changes of diabetes and diabetic retinopathy is the most common complication of diabetes, eye funds imaging is considered as a non-invasive and painless route to screen and monitor such diabetic eyes.

Fundus imaging has an important role in diabetes monitoring since occurrences of retinal abnormalities are common and consequences serious . However , since the eye fundus seems to be sensitive to vascular diseases, fundus imaging is considered as a candidate for non-invasive screening of diabetes. The success rate of screening depends on accurate fundus image capturing and especially on accurate fundus image capturing and especially on accurate and reliable image processing algorithms for detecting the abnormalities. Various algorithms have been proposed by many research groups for this purpose. As such is impossible to judge the accuracy and reliability of the approaches because of the lack of commonly accepted and representative fundus image database and evaluation protocol. The commonly accepted protocol could evaluate the maturity of state of the art methods that is to produce the achieved sensitivity and selectivity rates. This would finally allow the technology transfer from research laboratories to practice. Since diagnostic procedures requires attention of an ophthalmologist, as well as regular monitoring of the disease , the workload and shortage of personnel will eventually exceed the current screening capabilities . To cope up with these challenges digital imaging of the eye fundus ,provide a great potential . By automating the analysis process, more patients can be screened and referred for further examinations, and the ophthalmologists have more time for patients that require their attention since most of the eye fundus image are not leading to any medical action.

II. METHODOLOGY

The material of the research work is images. The dataset used was collected of healthy images and pathological images. There are some quality standard that must followed by the dataset. The below basis were considered roots for segregation:

1. The Images with various artifacts , like , intense and round spots produces by filth in the lens of the camera.
2. Salt and pepper noise affected the images great amount.
3. Vascular network is highly over segmented.

The proposed method includes various techniques. All these are explained with algorithm as below: To study how these photometric cues in the images should be utilized to detect the diabetic lesions, the previously described baseline algorithm and benchmarking framework are used.

In an experimental setting, the photometric cue of the lesions is extracted from the medical expert annotated images locations and using the baselines algorithm the lesions are modeled based on their photometric cue. The trained baselines algorithm is used in classification of the photometric information in the test images that results in for each test images the likelihood maps of the tested lesion types. The Pixel value in the likelihood maps denotes the probability that certain lesion type is present in that image location. To evaluate the performance and justify the selections made, the image- and pixel-based evaluation approaches of the benchmarking framework are applied to the likelihoods and likelihood derived images scores. The experimental setting is further modified by adding two steps prior to the baseline algorithm:1) a pre-processing step to investigate the colour space selection and both images illuminance and colour space selection and 2) a step to incorporate the background class information (background cue) to support the final decision making. The experimental setting is illustrated in Fig.

A. Preprocessing

a) Take bicubic interpolation.
b) Size of the image varies(2544*1696).
c) Image resized to standard size(512*512).
d) Bicubic interpolation is used for resizing and resize the image size.

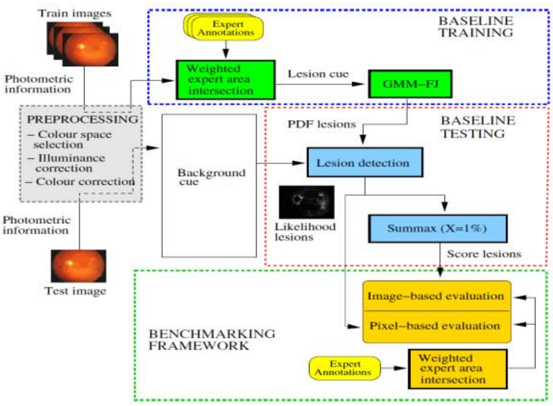

Figure 5.2: Experimental setting to investigate the use of photometric cues in lesion detection.

For the step involving removing of the exudates, we first analyzed the fundus images and got to finding the plane with the most contrast. The blue or green channel had more. Green tuned out to be the best. So further we processed all the channel of the images and arrived at a binary images. We further troedto find the convex hull of the binary image. Then we measured the area of the white portion(exudates) which when compared with photo of an earlier date can be used to check if the condition has improved or deteriorated.

B. Feature Extraction

The Local binary pattern explained below is applied to differentiate the texture of the retina background. They are determined for every pixel of the RGB images using P=8 different values of R={1,2,3,5}. The LBP values that match up with pixel locations of the optic disc, vessels, or outside the retina are not considered. The RGB components of each image are independently analyzed. The resulting images provide an explanation of the image texture. Later masking the optic disc and vessel segments, then LBP values within the external mask of the fundus are accumulated onto histograms, one for each component. Local Binary pattern is a technique which transforms an image into an array of integer labels that train the pixel wise details of texture images. These labels can be represented as a histogram that can be interpreted as the properties of LBP which make it attractive for characterizing textures are its invariance against any monotonic grey level change such as these caused by illumination changes, and its computational simplicity. The automatic image based evaluation follow the medical practice, where the decision are " subject-wise."The image analysis system is treated as a black-box wise takes an images as the input. If the image are assumed to br either normal or abnormal, then the system produces a score that corresponds to the probability of the image being abnormal, and a high score corresponds with high probability, The objective of the image-based evaluation protocol is to generate a ROC curve by Consider a 3*3 neighborhood around a pixel as sown in Figure .Pixel in the neighborhood with a grey value lesser or equivalent to the innermost pixel are given a value zero and those with a higher value are given value '1'. The 8 binary numbers linked with the 8 neighbors are then read consecutively in a clockwise direction to outline a binary number(LBP pattern) or a decimal number (LBP code).The number is allocate to the innermost pixel and used to characterize the local texture.

C. Classifier

The standard receiver operating characteristics (ROC) analysis is a frequently used tool to assess the performance of a two-class classification system. Originally, the ROC analysis was developed to evaluate the classification accuracy in differentiating signal from noise in signal detection, but recently the methodology has been adopted to various research areas. In computer vision, but the ROC analysis has also an acknowledged methodology in medical research has also turns out that the ROC analysis is well in accordance with medical decision making. In a clinical medicine, the diagnostic test is a measurement or examination used in classification of patients in a particular class or clinical state. If the outcome of such diagnostic test in binary (example normal or abnormal) there are four possible test for the test: true positive, true negative, false positive, false negative, For abnormal test subject.

D. Image based evaluation

Let the image analysis algorithm produced score values for n test images ‘a’ and the corresponding image -wise ground truths ‘b’, where the b is either “normal” or “abnormal” Then ,by selecting a threshold for the form of sensitivity and specificity can be determined by comparing the outcome with the corresponding is image-wise ground truth(wim).If the same procedure is repeated using each test image score as a threshold, the ROC curve can be automatically determined since each threshold generates a (sensitivity, specificity)- pair that is a point on the ROC

E. Pixel-based evaluation

To validate a design choice in method development, it may be useful to measure also the spatial accuracy that is whether the detected lesion are found in correct locations. Therefore a pixel-based evaluation is proposed. In this case, the Image analysis system takes an image as the input and output a likelihood score is to generate a ROC curve which describes the pixel-level success.

Let the image analysis algorithm produced pixel score values for all n pixels in the test set be pix={pix1,….,pixn} and the corresponding pixel-wise ground truth be *w*pix={*w*pix1,….,*w*pix n}, where the *w*pix is either “normal” or “abnormal.” Then, by selecting a global pixel-wise threshold for the pixel -wise threshold for the pixel score values, the pixel in all images can be classified to either normal or abnormal , Now, the sensitivity and specificity can be computed by comparing the outcome to the pixel-wise ground truth. If the procedure is repeated using each unique pixel score as threshold, the ROC curve can be automatically determined, The pixel-wise evaluation procedure is given in Algorithm 2. Note that the evaluation procedure is given in contribute to sensitivity and specificity , whereas the normal images only contribute to the specificity.

The evaluation forms a list of global pixel-wise scores from the test image pixel scores which determines the score thresholds. The use of all unique pixel scores in the test set is large or high resolution images are used. The problem can be overcome by sampling the test images pixel scores. To preserve the test set’s pixel score distribution, the global threshold scores can be devised as follows: 1) sort all the unique threshold scores can be in ascending order to form an ordered sequence L, and 2) compose the new reduced sequence of pixel cores Lsampled by selecting every jth likelihood in L.

F. Baseline algorithm

Images, ground truth, and the evaluation protocol are sufficient to establish a public benchmarking database. However ,by defining the users may find it easier to evaluate the maturity and applicability of their methods by themselves, A strawman algorithm that has been commonly agreed as benchmark for the method comparison within the research field would be the best choice for the purpose. Research field would be the best choice for the purpose. The baseline method method for DIARETDB0, however, is selected purely based on the practical reasons, and therefore it does not fulfill the characteristics of the strawman algorithm,. Regardless, it can be used to set the baseline results for the DIARETDB0 database.

III. IMPLEMENTATION

A. Database used

High resolution fundus(HRF) image database has been established by a collaborative research group to support comparative studies on automatic segmentation algorithms on retinal fundus images, The database will be iteratively extended and the webpage will be improved, This way we can extended our database of algorithms with the given results to keep it always up-to-data.

1. High resolution fundus(HRF) images database is nothing but DIARETDB0. In the testing of a baseline algorithm , a likelihood map for each test images in the DIARETDB0 database is computed according to the estimated class-conditional probability density function

2. The hardware require for automated fundus analysis system includes, A windows based personal computer with at least 1gb of Random access memory (RAM) and super video graphics array (SVGA), colour monitor, optical printer and networking system should also be available.

3. Software tool used

Matlab2013b:MATLAB is a high performance language for technical computing .It integrates computation, visualization and programming in an eye-to-use environment where problems and solutions are expressed in familiar mathematical notations.

CONCLUSION

In this project on the basis of colour information , the presence of lesion can be preliminarily detected by busing Base line algorithm method . DIARETDB0 is in many ways a difficult database, but it corresponds to the situation in practice: the image are uncalibrated, expert evaluation is free form and the display used to view the image are uncalibrated the following development steps will be taken:

- Findings are classified based on the confidence level (high ,medium ,low) given by the expert. All findings are independently verified by several experts.
- Sensitivity and specificity measures has shown an improvement for the selected images.

- Localization accuracy has shown an improvement while identifying the Soft/Hard Exudates.

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