DAIBETIC RETINOPATHY SCREENING

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ABSTRACT

The enormous capability that the Artificial Neural Network (ANN) provides as an analysis tool can be extended to the field of retinopathy. ANNs can be used for adopting retinopathy techniques for diagnosis of diabetes starting with its detection. In concert to similar works currently going on, we propose, such a diabetes detection method using Artificial Neural Network (ANN) and a feature set formed adopting Singular Value Decomposition (SVD) and Principal Component Analysis (PCA). Then, we apply a composite feature set adopting SVD and PCA sample values of the Fundus retinal image.

I. INTRODUCTION

Human eyes are the parts which are responsible for the sight sense which is the most important among the 5 human senses organs because they are the unique window by which the human can see everything around him, and all the recent technologies in the world cannot compensate their functions by an alternative. On the other hand, status of human eyes can provide early signs about many other diseases like diabetes, cardiovascular and hypertension. In addition, examination of eye vasculature can assist to predict early the heart attack and stroke [1].

Diabetic retinopathy (DR) is a common retinal complication associated with diabetes. Patients may see floating spots or almost total darkness. Sometimes the blood will clear out by itself. Over the years, the swollen and weak blood vessels can form scar tissue and pull the retina away from the back of the eye. If the retina becomes detached, patients may see floating spots or flashing lights. Unfortunately, in many cases the patient is not aware of any symptoms until it is too late for effective treatment. Detection of the disease is important to prevent vision loss. Retinopathy tries to find the status of the eye by analyzing the surroundings of the retina and thereby provide certain symptoms from which conclusions can be made regarding the nature of the disease.

For use with an ANN a robust and computationally efficient approach for the localization of the different features in a Fundus retinal image is presented in this work. The work proposes certain approaches for extraction of diabetes retinopathy features using SVD and PCA and applying it to ANN for training. The detection of hemorrhages and exudates are important in order to diagnose diabetes retinopathy for preventing loss of eye sight. Experimental results show that the ANN and SVD-PCA composition is a reliable means of diabetes detection using retinopathy based techniques with less computational complexity and high accuracy[1][2][3].

In automatic disease detection system can significantly reduce the load of experts by limiting the referrals to those cases that require immediate attention. The reduction in time and effort will be significant where a majority of patients screened for diseases turn out to be normal.

II. APPLICATION DOMAIN

Medical images have been increasing rapidly in volumes and there is an impending need to organize, retrieve and annotate the data that is expanding at an alarming rate. These coupled with the high demand of quality health services lead to a nature choice for computational tools. Over the last few decades, medical image analysis has been a wide spread research area and have gained the interest of many scientist and physicians. The motivation behind this aspect is their abilities to offer fast, objective, and reproducible quantification mechanism to provide the much needed tools to assist doctors in daily clinical practice such as medical diagnosis, monitoring and automated discovery of diseases. The appreciation is that once an automated system is able to achieve the desired accuracy with rapidity; it can be deployed as a routine, acceptable and cost effective approach for assistance of daily clinical use. Till date, researchers have developed many algorithms in many medical domains such as Magnetic Resonance Imaging (MRI), Computed Tomography (CT), Mammography, etc. In one way or the other, algorithms have been detected to either automate disease discovery or to assist in clinical practice. However, there is still a problem of achieving the desired reliability and precision suitable for daily clinical use.

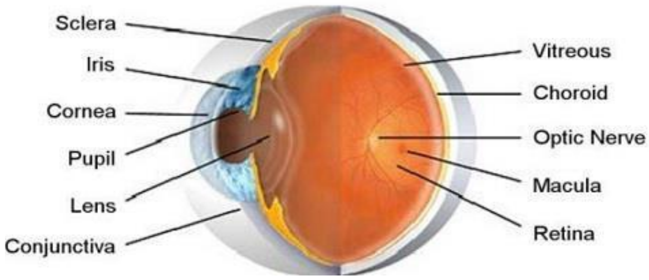
This is a generic problem within many high-level computer vision applications and Diabetic Retinopathy image analysis is one of such applications. Diabetic retinopathy (DR) is a common complication of diabetes, an eye disease that has been one of the major causes of blindness in the world for adults under the age of 65 (WHO, 2008). Diabetic Retinopathy damages the small blood vessels in the retina which may then leak into the retinal or may cause new fragile blood vessels grow and may cause hemorrhages. In either situation, it ultimately results in a loss of vision if left untreated.

III.DIABETIC RETINOPATHY LITERATURE

Research in retina image analysis have spanned for almost 25 years. It is known to be a complex task because of its variability of the images, anatomical-pathological structures and the appearance of visually similar clinical signs. All these factors can lead to erroneous interpretation of the image. This part of the chapter attempts to define a timeline over the past two decades on the various techniques used to detect both anatomic structures such as optic disc, blood vessels and clinical signs such as micro aneurysms, exudates and haemorrhages.

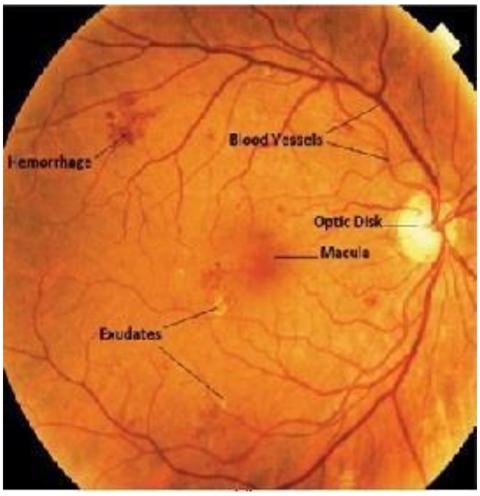
ANATOMIC STRUCTURES OF THE RETINA

The retina consists of three main anatomic components, the optic disc, blood vessels and the macula. It is essential to detect these components as well and at later stages, use it as a means to remove false positives to facilitate accurate detections of other clinical signs.



CLINICAL SIGNS

DR clinical signs include micro aneurysms, exudates and hemorrhages. In this section, the literature of detecting these DR clinical signs is discussed.



OPTIC DISC DETECTION

Optic disc detection is necessary for diagnosing of any pathological disease in retina images. The advantages for locating the position of the optic disc are numerous. Firstly, the shape and size of the optic disc changes dramatically during the course of the disease denoting the severity of the disease. Secondly, it would help with the locating of other anatomic structure such as the macula and blood vessels.

Lastly, locating the actual position of the optic disc will improve the bright lesion detection Performance by removing potential false positive regions as they share similar visual characteristics with other bright pathological signs. On the other hand, because of such similarity, locating the optic disc is challenging when other bright lesions are also present in images and can be mistaken as optic disc. Furthermore, finding the boundary of the optic disc are made difficult by the irregular shapes of the optic disc in pathological cases as well as the appearance of blood vessels within the optic disc.

BLOOD VESSEL DETECTION

Blood vessels are one of the main components in the retina and it has been found that in several pathological diseases, the changes in the appearances and the structure of the blood vessels such as the diameter or tortuosity can help diagnose the severity of the diseases. Furthermore, the location of the blood vessels can aid in the detection of other anatomical structures such as the optic disc and the macula. Therefore, detection of the blood vessels is imperative in an automated screening system. Their characteristics are such that they appear darker as compared to the background and they gradually decrease in width as they grow from the optic disc. Segmentation of the blood vessel from the background is complex due to the uneven illumination in retinal images. If the image‟s histogram is bi-modal where there are two distinct peaks, thresholding could be easily applied to segment the blood vessel. from the background. But in reality, this does not happen as background variations and the appearance of other bright lesions results in a multimodal histogram where there are more than two distinct peaks.

MICRO ANEURYSMS

Micro aneurysms are swelling of the capillaries that are caused by the weakening of vessel walls due to high sugar levels in diabetes and they eventually leak to produce exudates (which will be discussed in Section 2.3.5). Micro aneurysms are the first visible clinical sign to appear in diabetic retinopathy and it is known that quantities of this symptom can help diagnose the progression of the disease. They are therefore, an early indicator of the disease and are of primary importance for an automated screening system. In retinal images, micro aneurysms appear as small reddish dots with a circular shape and have similar intensity values as haemorrhages and the blood vessels. The challenge in detecting the micro aneurysms is due to their similarity to hemorrhages which can appear as a „dot‟ or „blotchy‟.

Differentiating between micro aneurysms and „dot" haemorrhages proves to be difficult even for human experts. Hence, they are usually detected together and associated with a single label. The variance in images caused by uneven illumination and pigmentation in the retina are also factors that further complicate the processing. Techniques in micro aneurysms detecting over the past two decades have remained similar. They all involved a feature extraction for candidate regions, followed by either a rule base of criterion elimination or a classification process. summarizes the state of the art in micro aneurysms detection throughout the past two decade.

IV. SUMMARY ON DIABETIC RETINOPATHY IMAGE ANALYSIS

In summary, the literature has reviewed the state of the art in retina image analysis for the past two decades. These techniques range from various image-processing techniques to machine learning techniques. Although some of these studies reported good results, there are a few limitations:

- Some of the literature uses pure image processing techniques to detect the various structures (both normal and abnormal structures) of the retina. They do not contain any form of recognition resulting in ambiguous detection.

- Previous works focuses only on a few clinical features and mostly based on small data sets that were unable to realistically model the true spectrum of image quality and variability occurring in real clinical scenarios.

- Accurate segmentation of subtle clinical signs is still a challenging problem due to the variability in retina images and still very prone to under/over segmentation resulting in detection errors.

- Current attempts to build classifiers for detecting DR signs all have one thing in common they use a single classifier. Traditional classifiers would not be capable to deal with such a large scale of data because the set of features used would not be able to fully represent the data.

- Current detection of clinical signs is all treated in isolation. There are no further analysis on the relations between various elements within the image for more coherent understanding of the image.

Based on the limitations listed above, it is apparent that the success of retina image analysis requires a different approach. Majority of the research uses a traditional classifier approach,

and these are unsuitable because it is unlikely that refinement of classification would be successful over data of such magnitude. The crucial element missing from many studies is the contextual information from each detection that can be complimentary and when integrated together, to enhance the overall accuracy.

At present, the approach undertaken by a team in Aberdeen, Scotland (Fleming et al., 2006; Philip et al., 2007) is, to date, the only research team utilizes complimentary information to enhance the robustness of their algorithms during detection with excellent scalability. For example, in optic disc detection, they utilized information from the blood vessels to enhance the accuracy.

During exudate detection, information at different resolutions was taken into consideration for obtaining candidate regions. Furthermore, their team is the only research body that gained access to large amounts of diabetic retinopathy images to test the scalability of their work. Their research involved separating disease/no disease images and was evaluated over 6722 patients amounting to 14406 retina images. Their framework involved detecting various entities pertaining to the anatomy of the retina and clinical. signs related to diabetic retinopathy. For their framework to separate disease/no disease retina images, they obtained 90.5% sensitivity and 67.4% specificity. The research in this thesis attempts a different approach where evolutionary algorithms play a key role. This thesis investigates the possibility of deriving the final interpretation of the image based on all the detected entities in the image. Evidence are obtained from different processing and through reasoning, combined together for an optimized result. The whole framework used in this research is optimized using evolutionary algorithms to ensure that classifiers and the contextual models are representative of the true magnitude of the training data. It is all these aspects that separate this research from current studies. The next few sections discuss techniques and theories that can help achieve this framework.

V. ALGORITHM FOR IMAGE PREPROCESSING

- Image Acquisition

- Reading the image

- Pre Processing and Normalization

- Step 1: Converting to Gray scale from rgb

- Deleting extra portion
- to find the radius of pupil

- Step 2: Resizing the image(546x644) to 512 x 512

- Step 3: Histogram Equalization

- equalizes the contrast

- Step 4: Gaussian Filtering

- Filter it the image

- Display

- Step 5: Canny Edge detection

VI. CONCLUSION

In this work, a composite feature set is used for detection of diabetes using ANN. The feature set formed using PCA and SVD components provide satisfactory performance. It shows at least 2-3% Improvement in accuracy and 5-8% lowering of processing time compared to the case when the entire Image is used as a feature. The framework thus proposed provides certain insight into the Development of a bloodless diagnostic approach for detection of diabetes.

VII. REFERENCES

[1]Abandah, G., Younis, K. and Khedher, M. (2008). Handwritten Arabic Character Recognition Using Multiple Classifiers Based on Letter Form, International Conference on Signal Processing, Pattern Recognition, & Applications, pp. 128-133.

[2] Archana deka &kandarpakumar Sharma "ANN based detection of diabetes using retinopathy".

[3] U. M Chaskar, M. S. Sutaone "On a Methodology for Detecting Diabetic

Presence from Retina Image Analysis".

[4] Anitha Mohan1, K. Moorthy2 "Early Detection of Diabetic Retinopathy Edema Using FCM."

[5] Bernhard M. Ege, et al, "Screening for diabetic retinopathy using computer based image analysis and statistical classification" Elsevier, Computer Methods and Programs in

Biomedicine 62 (2000) 165–175.

[6] Oliver Faust & Rajendra Acharya U. & E. Y. K. Ng & Kwan-Hoong Ng & Jasjit S. Suri

"Algorithms for the Automated Detection of Diabetic Retinopathy Using Digital Fundus Images: A Review"

[7] A. Aquino, Gegundez-Arias, M.E.Marin: ``Detecting the Optic Disc Boundary in Digital Fundus Images Using Morphological, Edge Detection, and Feature Extraction Techniques", IEEE Transactions on Medical Imaging, vol. 29, pp. 1860 - 1869, Huelva, Spain, 2010.

[8] Oliver Faust & Rajendra Acharya U. & E. Y. K. Ng & Kwan-Hoong Ng & Jasjit S. Suri

"Algorithms for the Automated Detection of Diabetic Retinopathy Using Digital Fundus Images: A Review"

[9] Diabetic Retinopathy, ..http://www.craigbergermd.com/diabeticRetinopathy
.htm". Accessed in May 2012.

[10] Anatomy and Structure of Human Sense Organs, ' 'http://wwwscientificpsychic.com/workbook!chapter2.htm". Accessed in November 2013.