DETECTION OF RETINAL FEATURES FOR DIAGNOSIS OF DIABETIC RETINOPATHY

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ABSTRACT

Human Retina has potential to reveal important information about retinal and ophthalmic diseases. Retinal imaging is being analyzed for the study of different diseases over the years. It has a stream of featured blood vessels. Change or modification in these blood vessels can trigger the abnormalities that could lead to a certain disease while the disease is still in its earliest stage. A large scale screening implementation is generally required for identifying any victim of these diseases that involves efforts in acquisition of the retinal images and examining these images under different benchmarks. There was a need to research and made the system for better detecting the symptoms for different ophthalmic disease victim. The declared system for detection of diabetic retinopathy and macular degeneration had been intake the insight from all of those feature detection approaches and delivered full screening system for these diseases. The screening system involved image acquisition, noise removal, image centering, region selection, vessel segmentation, feature extraction, and classification. The system has been first implemented on some publically available datasets and then looked for the operational capabilities of the system by running some clinical diagnosis over it.

Keywords: Diabetic Retinopathy, Exudates Detection, Macular Degeneration, Retinal Diseases.

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I. INTRODUCTION

Diabetes is a common disease around the world that is caused by insulin deficiency in human body. Diabetes patient needs to check his insulin frequently to avoid weakening and ultimately damage any organ. The diseases that a diabetes patient develop with the passage of time includes diabetic retinopathy, age linked macular disintegration etc. (Gibson, 2012) and the numbers are progressing rapidly. The advanced phase of these diseases may have heart attacks or strokes, nephropathy, etc. that may lead to death. Diabetic retinopathy develops severely in poor metabolic control, pregnancy, hypertension, smoking, etc. (Harney, 2006).

There is a huge prospective of Human Retina to expose important information related to retinal plus ophthalmic illnesses. Retinal imaging is actually analyzed to the study of several diseases concluded from the years. Humanoid Retina takes a watercourse of featured lifeblood vessels. Alteration and modification in particular blood containers has been trigger the irregularities that have leaded to a definite disease despite of that the disease is facing the beginner level stage since. Early recognition and subsequent behavior might be prevented the dissolve advancement of these sicknesses. In place of the time movements, these kinds of diseases have become so common. A huge scale transmission implementation is commonly required for recognizing and investigating any target of these sicknesses which is involving efforts in acquirement of the retinal photographs and exploration of these images underneath different standards.

Hard Exudates – these are bright lesions (Figure.1)with enough spacing that individual exudate can be noticed. The presence of exudates within the macular region is a main hallmark of diabetic macular edema and their numbers signifies the severity of disease (Amel*et al.*, 2012).

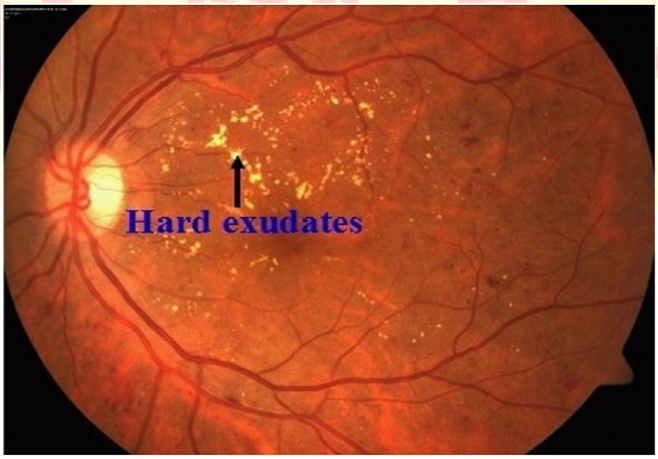


Figure 1. Hard Exudates (Annotated with arrow)

Soft Exudates – soft exudates or cotton wool spots (Figure.2) are concentrated lesions at the nerve fiber layer entering to the retina. These are caused by the stoppage in the movement of a fluid. These are bright lesions and have high contrast to the background (Harney, 2006).

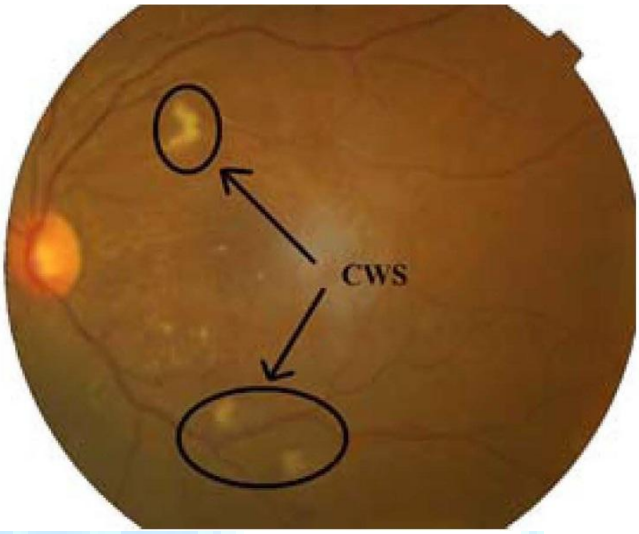


Figure.2.Soft Exudates or CWS (Annotated with arrow)

Micro aneurysms – these lesions are said to be the earliest symptom of retinal damage. These lesions are caused by thinning of retinal blood vessels. It is a red lesion with maximum size of 120 μm (Mookiah *et al.*, 2013).

Hemorrhages – these lesions are caused due to the seepage of blood in week capillaries. These lesions are referred as the preliminary symptom to be diagnosed in patients with diabetic retinopathy (Gibson, 2012).

Macular Edema – like hemorrhages, it is also caused by leakage in week capillaries and the flood is seeped and solutes at the macula. Macular rotational symmetry is benchmark to characterize the mild macular edema while if it does not exhibit symmetry, there is a high risk of macular edema and require immediate attention (Deepak and Sivaswamy, 2012).

In section II there are some discussions about previous studies and literature cited. Then in section III different approaches are used in the methodology has been described.Section IV is covered by the best proposed solution. The result and discussion are elaborated in the section V.At the end of the paper a precise conclusion is written in the section VI.

II. BACKGROUND STUDY

There are numerous tactics that are regularly used in this work previously for detecting the structures such as exudates, strand material a skin circumstance, micro-aneurysms, plasma loss, drusen, ischemia, etc. Altogether, the used procedures acquired locality, size, figure, roughness, edges material, brightness, shade details and distance of those features. Such all systems take in image achievement, noise subtraction, image focusing, region selection, vessel segmentation, feature withdrawal and feature cataloging (Stewart, 2005).

Humanoid Eye Retina has been capable enough to investigate about the illness caused by the retina. So that every researcher and specialists had been studied about Retinal photographs from past many decades and extract the important information about this sickness. Human Retina having the naturally grounded lifeblood vessels from which the meaningful data can be extracted for proper cure. The research on these vessels has been leaded towards finding the sickness caused by Diabetic and slowly damaged the eye and even ending at blindness (Abramoff *et al*., 2010).

Moreover application of enormous scale transmission programs, the programmed investigation of retinal lifeblood veins has been assisted in categorizing the sicknesses in an additional appropriate manner. There were many different properties in retinal blood veins which had been decisive for transmission of several ophthalmic disabilities for example diabetic retinopathy plus age-related ME (Macular Edema) said, (Mookiah *et al*., 2014).

The before time investigation and succeeding therapy has might be able enough to prevent the illness level from sever development and informing earlier about the disease has been leaded towards the clear betterment. As per time advancements, this severe disease has been ever so communal and got awaked by many. An enormous scale screening employment has been generally mandatory for recognizing any target of these sickness that involves determinations in procurement of the photographs of Retina and inspecting these photographs by means of several rules and standards (Franklin and Rajan, 2014).

III. METHODOLOGY

For screening the patient's vasculature in their retina regarding diabetic retinopathy and age related macular degeneration this research will use database publically available and toolkits that are used with development kit. It includes MATLAB for image analysis. This system is going to segment features from retinal images depending on their anatomical structure and representation. Further it will classify those features from a class of features that are subjected from presence of retinal disease such as DR.

There are multiple approaches for manipulating this research. Almost all approaches use three principle steps for DR detection; i.e. candidate selection, feature extraction, feature classification and DR grading. For candidate region selection, system will use active contour methods (Harangi and Hajdu, 2014) that are based on shape parameters and inter-class covariance of different neighborhood windows in the image. Feature extraction would be done by thresholding among those candidate regions (Akram *et al*., 2014).

For classification of those features, this system would use learning from datasets that have labeled images with features; i.e. exudates, hemorrhages, micro-aneurysms, etc. and test on the test images (Zhang *et al*., 2014). Grading of DR would be based on occurrence of each feature and their relative coherence with other lesions (Akram *et al*., 2014).

Areas of Applications are defined below in which the above mentioned approaches and tools are going to be applied in the proposed research:

- Feature extraction.
- Screening of ophthalmic diseases.
- Diagnosis the severity and stage of those diseases.
- Improved healthcare with reduction of risk of vision loss.
- Statistics for patients.

IV. PROPOSED SOLUTION

There is a requirement to automate the structure for better distinguishing the symptoms for unalike ophthalmic disease targets. The proposed investigation for detection of the diabetic retinopathy plus macular-degeneration would aperture the awareness from all of individual's feature uncovering approaches and would distribute fully computerized screening system for these infections. The computerized screening method would encompass image acquisition, sound removal, image pinpointing, region collection, vessel separation, feature abstraction, and classification. The system would be leading in implementation on particular publically existing datasets in addition it will appeared for the functioning capabilities of the structure by running on certain clinical identifications over it. The eventual goal is to accomplish a target of robust, well-organized and monetary screening structure for perceiving these diseases. The proposed investigation work will be further prolonged to support photograph acquisition by mean of mobile ophthalmoscope incorporated with smart phone. That is endangered to funds and obtainability of apparatus though. The aim for this postponement would enable large measure screening even at the distant off places where it will capture the images without a typical fundus camera.

V. RESULTS & DISCUSSION

Automated and computer based methodologies were used in the performance of this study on datasets of fundus images. We were able to find and recognize different vasculature features that can lead to pathologies caused by diabetes. In section 2, we have also provided some studies related to the field of study and we have emphasized on due effectiveness and necessity of practicing the good performance measures to prevent such diseases. We have described different techniques that help us in process of conducting research in the very field. We have stated how we have coped different aspects of the automated and computer based detection system. The system has been decomposed in many parts of feature detection such as optic disc, macula, vasculature structure and the implication such as exudates that are crucial in the phase of detection of diabetic retinopathy. Here we are analyzing the results of each portion of our research.

We made use of Fourier as well as Wavelet transform to see images in a very different manner. We have enhanced the composition of the vasculature structure through maximization of decomposed images from wavelet transformed images that are been decomposed in half the size (Figure.3.1, 3.2).

Figure.3.1Decomposed Image

we apply a large sizedmean filter on resultant image that incorporate mean of local neighborhood of 10 by 10.

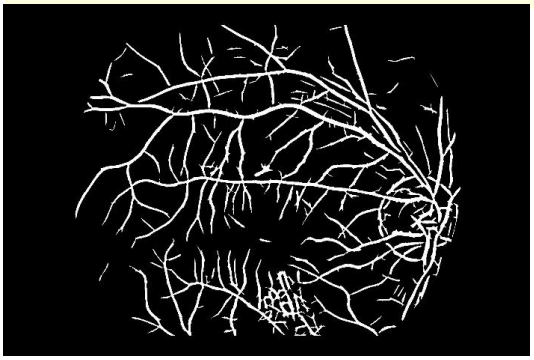


Figure.3.2 Decomposed Image

Figure 4 depicts the result of mean normalization.

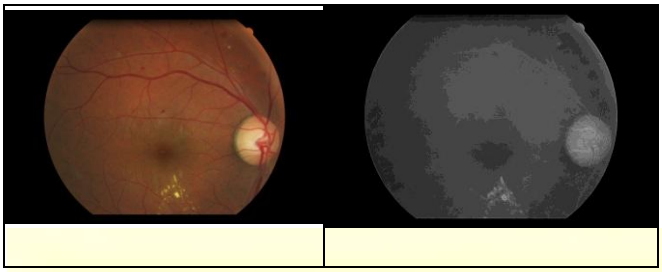


Figure.4. Mean Nomalization

The thresholding candidate extraction algorithm starts by calculating a global histogram and several local histograms by partitioning the original image into non-overlapping square blocks.

We perform morphological closing with 8 sided octagons as structuring element because we see often exudate appear resembling to octagon. The resultant image consequent background of the image, which is further subtracted from the original red channel of the image, is shown below.

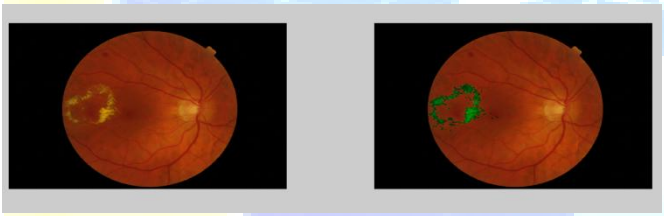
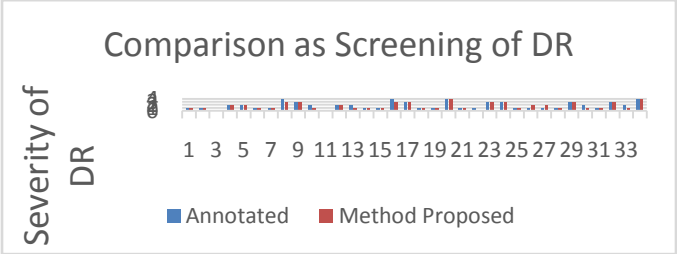


Figure.5. Segmentation Results for Exudates in some images

We perform region wise (exudate level), stage wise (severity of the patient retina) and pixel wise (image level) evaluation of the results by combining the regions and number of pixels belonging to the regions of exudates and total number of pixels of the exudate. Following sections cover the evaluation.

Our algorithm has run just fine enough to screen out the patients as we consider that the patient that has symptoms of Moderate or Mild Diabetic Retinopathy may visit the doctor. Our comparison with the annotation marked by the ophthalmologists is shown in the following graph.



We take the rough estimate of the severances of the disease with the number of exudate regions found in the images. The following intimations have been made for the severity of the diabetic retinopathy.

Number of Exudate Regions	Severity
0-10	Beginning
10-40	Moderate
40-70	Mild
70-100	Severe
Above 100	Critical

Table 1.Va;idation Stage

We saw that the images in the e-ophtha EX database are of such large size that it could not be easy to run the algorithm in real time even on a high performance computer because the images are of size of 1696 × 2544 pixels. Thus we resize image to 752 × 1128 pixels to reduce the amount of time on operating. It takes almost 19 seconds on each image from start to the diagnostic result producing on a conventional computer (Core i3). If we can operate on one channel of the image, we could even reduce the amount of time taken on the screening process.

Our algorithm has been run under the accuracy of 88% which is too low but it cannot be underestimated as still it can screen out the patient with possible symptoms of diabetic retinopathy as we see in stage-wise validation of our algorithm.

VI. CONCLUSION

Retinal structure is very fair and precise if functioning good but little impairments and damages can prompts different kind of abnormalities in the retinal configuration. These abnormalities are to be

figured out and stimulated as early as diagnosed.We incorporated research of many authors that are reviewed and cited in the phase of literature survey. We adopted the algorithms and approach that have been the best under the circumstances of screening of diabetic retinopathy. The evaluation is done explicitly too, that is to determine how best have we been able to recognize our algorithm for the benefit of screening of diabetic retinopathy. We made use of up-to-date and state-of-the-art algorithms to put up a whole new procedure of diagnosing diabetic retinopathy.

VII. FUTURE WORK

We aim to improve the effectiveness and adaptability of our algorithm in future. We also aim to work for other impairments that too lead to the diabetic retinopathy.

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