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EARLY STAGE DETECTION OF DIABETES FROM FUNDUS IMAGE OF EYE USING DIABETIC RETIONOPATHY

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ABSTRACT

Diabetes is a quickly expanding overall issue. The most widely recognized confusion of diabetes is diabetic retinopathy (DR), which is one of the essential drivers of visual deficiency and visual hindrance in grown-ups. In this paper, a calculation is proposed for the early and exact detection of the diabetic retinopathy. Fundus images are taken from DRIVE database. In the initial stage image undergo pre-processing steps. Canny edge detection is also applied to extract the fragile blood vessels. Performance of the algorithm is calculated by using accuracy, AUC and specificity.

Keywords: Fundus, Diabetic Retinopathy

1. INTRODUCTION

Analysis of the retinal blood vessels (vasculature) from fundus images has been widely used by the medical community for diagnosing complications due to hypertension, arteriosclerosis, cardiovascular disease, glaucoma, stroke and diabetic retinopathy (DR). According to the American Diabetes Association, DR and glaucoma are the leading causes of acquired blindness among adults aged 20-74 years with estimates of 4.2 million Americans having DR and 2.3 million having glaucoma in 2011. Automated blood vessel segmentation systems can be useful in determining variations in the blood vessels based on the vessel branching patterns, vessel width, tortuosity and vessel density as the pathology progresses in patients. Such analyses will guide research towards analyzing patients for hypertension, variability in retinal vessel diameters due to a history of cold hands and feet and flicker responses.

Existing automated detection systems for non-proliferative DR detection require masking of the vasculature to ensure that the blood vessels are not mistaken for red lesions that are caused by DR. Also, automated detection of proliferative DR requires analysis of the density, vessel width and tortuosity of the blood vessels. A fast and accurate segmentation algorithm for detecting the blood vessels is necessary for such automated detection and screening systems for retinal abnormalities such as DR. Some existing unsupervised vessel segmentation methods have achieved up to 92% segmentation accuracy on normal retinal images by line-detector and template matching methods that are computationally very fast. However, increasing the segmentation accuracy above 92% for abnormal retinal images with bright lesions (exudates and cotton wool spots), or red lesions (hemorrhages and microaneurysms), or variations in retinal illumination and contrast, while maintaining low computational complexity is a challenge. In this chapter we separate the vessel segmentation problem into two parts, such that in the first part, the thick and predominant vessel pixels are extracted as major vessels and in the second part, the fine vessel pixels are classified using neighborhood-based and gradient-based features.

Vision is arguably the most used of the five senses in the human body. We rely on our eyes to provide most of the information we perceive about the world, so much so, that a significant portion of the brain is devoted entirely to visual processing. The eye is often compared to a camera because of the way it processes light into information understandable by the brain. Both have lenses to focus the incoming light. A camera uses the film to create a picture, whereas the eye uses a specialized layer of cells, called the retina, to produce an image.

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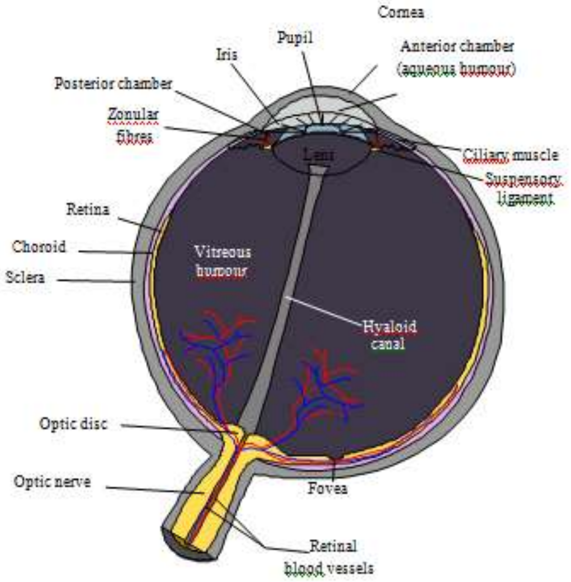

Figure 1.1: Global eye's anatomy

The eye's ability of focus on a wide range of objects having different sizes, luminosity and contrast at a high speed is more powerful than those of current cameras. Figure 1.1 shows a schematic view of the anatomy of eye. Light reaches the eye by first passing through the cornea which filters it, and begins focusing the image. The anterior chamber contains a viscous substance called aqueous humour, that keeps the front of the eye firm and slightly curved. Light travels through the pupil, which compensates for changing light conditions by contracting or relaxing. The muscles responsible for these movements are in the iris. Subsequently, the lens squeezes or stretches to focus the rays of light on the retina.

The interior surface of the eye, opposite the lens, is called the fundus. The retina is a multi-layered sensory tissue that lies on the back of the eye. It contains millions of photoreceptors that capture light rays and convert them into electrical impulses. These impulses travel along the optic nerve to the brain where they are converted into images. There are two types of photoreceptors in the retina: rods and cones, named after their shape. Rod cells are very sensitive to changes in contrast even at low light levels, hence able to detect movement, but they are imprecise and insensitive. The retina is a multi-layered sensory tissue that lies on the back of the eye. It contains millions of photoreceptors that capture light rays and convert them into electrical impulses. These impulses travel along the optic nerve to the brain where they are converted into images.

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2. PREVIOUS LITERATURE

In diabetic retinopathy another contribution of this survey is the summarization of the basic algorithms and various platforms. This can be providing a quick view on optimization goals and the approaches adopted by a group of research works.

Lucia Ballerini workd on a computational approach for the screening and quantifying diabetic retinopathy. Specific consideration had been paid to the investigation of Foveal Avascular Zone (FAZ). Truth be told, retinal slender impediment created a FAZ development. Also, the FAZ was described by subjective changes demonstrating a sporadic shape with notchings and spaces. They proposed a programmed division system got from the hypothesis of dynamic shape, otherwise called snakes, alongside hereditary improvement. They likewise attempted to separate highlights which can catch the measure of the question, as well as its shape and spatial introduction

The diabetic retinopathy is also performed by using image processing. It incorporates the Detection of Exudates in Color Fundus Images of the Human Retina. The commitment of picture handling to the conclusion of diabetic retinopathy might be separated into the accompanying three gatherings: 1) picture upgrade; 2) mass screening; 3) checking of the infection.

A method for computerized screening and distribution of vascular anomalies into classes in Diabetic Retinopathy was also introduced meanwhile in research. The vascular irregularities are detected using scale and orientation selective Gabor filter banks. The planned method categorizes the retinal image as mild or severe case based on the outputs attained from Gabor filters.

An application of the information of advanced picture preparing, fuzzy rationale and neural network method to recognize bifurcation and vein-course traverse focuses in fundus pictures was introduced as an advanced development stage. The procured pictures experience preprocessing stage for enlightenment evening out and commotion evacuation. Division arrange bunches the picture into two particular classes by the utilization of fuzzy c-implies procedure, neural system strategy and altered cross-point number (MCN) techniques were utilized for the identification of bifurcation and traverse focuses. MCN utilizes a 5x5 window with 16 neighboring pixels for proficient discovery of bifurcation and traverse focuses in fundus pictures. Result acquired from applying this half and half technique on both genuine and recreated vascular focuses demonstrates that this strategy perform superior to anything the current straightforward cross-point number (SCN) strategy.

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(SCN) strategy different channel various element word references for hopeful portrayal. Next, meager coefficient got by the proposed JDSR calculation which utilized for arrangement. Furthermore, to frame an ideal word reference, the gathering sparsity lexicon determination technique was presented. They assess calculation by contrasting it and other best in class calculations. Broad test comes about on ROC database exhibit the adequacy of the proposed calculation.

3. METHODOLOGY

The process is to get input from retinal fundus data set then pre-processing techniques are applied on retinal image. After that morphological tasks are performed to recognize or extraction of highlights. Highlights can be separated utilizing proper filters. At last by utilizing classifier for giving severity or grade of abnormality.

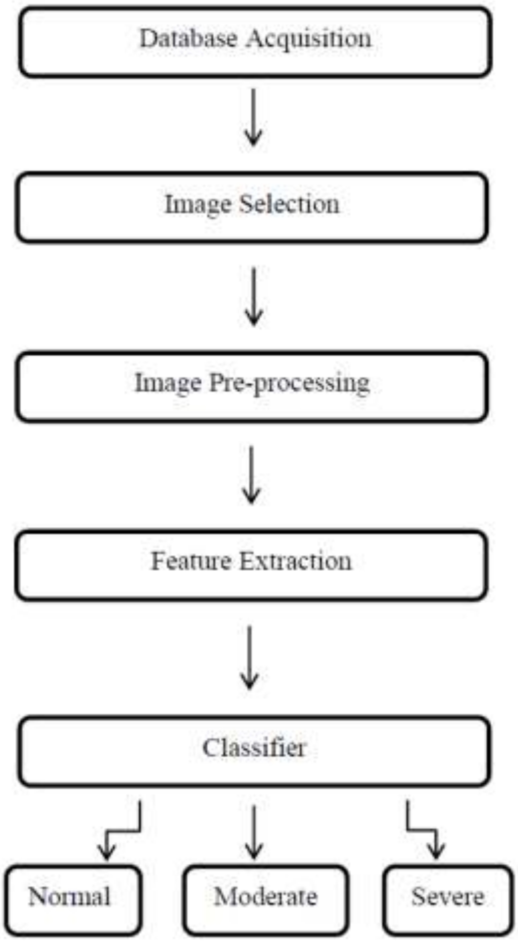

Figure:2 Process of Diabetic Retinopathy

Database acquisition: A basic tool for reliable detection of diabetic retinopathy is a database comprising a selection of set of high quality medicinal images which are representatives of diabetic retinopathy and have been verified by experts. In this DRIVE database is used. Digital Retinal Images for Vessel Extraction (DRIVE) is an openly accessible database comprising of forty colour fundus photos has been utilized broadly to test various programmed vessel extraction calculations.

Image selection: An image is selected from the database to detect diabetic retinopathy and to classify under three stages of NPDR.

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Image Pre-processing: In pre-processing stage, the image is get resolved several difficulties such as blurring, non-clarity and size of image. In this stage resizing of the image is done and then color space conversion problem, image restoration and as a final point improve the image.

Feature Extraction: Detection of diabetic retinopathy involves medical identification of dilation of blood vessels, presence of exudates, lesions or any other anomalies in the retinal images. Fundus retinal images not only provide structural data of the retina, but also the information of these pathological features. In a healthy retinal image, the features detected are web of blood vessels, macula and the optic disc. Any variation due to diabetic retinopathy will cause variation in these noticeable features. Gabor filter is used to extract the features.

Results
The experiment is performed I MATLAB R2010a. Following are the results that have been achieved for optimizing the results. The whole simulation performance is measured using various metrics as shown below:

Figure3: Main Window

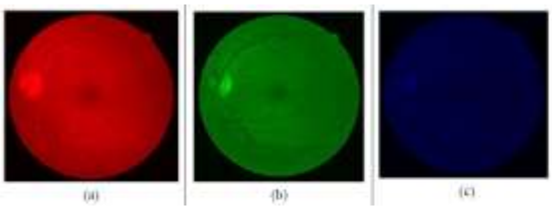

Figure4: Channel Extraction a) Red Channel output, b) Green Channel output and c) Blue Channel output

The RGB selected image is split up into three components i.e. red, blue and green. Above pictures show the red, blue and green channel extracted images. In which green channel has higher information or in other words green channel has clearly visible blood vessels.

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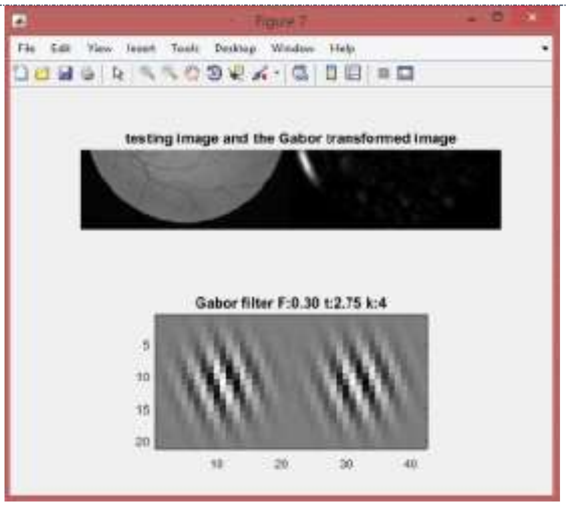

Figure5: Gabor Filter

Result are calculated by using three parameters i.e. specificity, AUC and accuracy having values **97.7861, 96.6846 and 95.7825** respectively.

Diabetic retinopathy has been done earlier using various algorithms and the results were good but there are other ways by which results can be improved. In existing system they used morphological operations of image processing to extract the features of diabetic eye. In proposed system we used gabor filter to extract features. The results calculated are quite impressive.

Algorithm	**Specificity**	**AUC**	**Accuracy**
Literature	97.40	93.80	92.40
Ours	**97.81**	**96.72**	**95.86**

4. CONCLUSION

Diabetes has gotten a hold on roughly 10 % of aggregate populace around the globe, and India known for capital of diabetic, diabetic retinopathy (DR) is one among a noteworthy outcome of diabetic. In fundamental stage, anomalous changes occur in retinal surface pattern. Besides it can be prompt permanent vision misfortune at the last stage. The manual procedure of DR Detection depends on visual image analysis and if the DR is recognize in the beginning time, the harm of eye is totally preventable or treatable.

The proposed highlights demonstrate a huge potential for NDPR discovery and characterization. In this DRIVE database is used. The features are extracted by using gabor filter and canny edge detection. In this MATLAB is used and results are analysed in terms of Specificity, Accuracy and AUC (are under curve). A calculation can distinguish NDPR with a specificity of right around 97.8%, while NDPR can be characterized with an exactness and AUC of 95.7825% and 96.6846% individually at normal on 40 DRIVE retinal pictures. A calculation reliably indicates better outcomes those other machine learning calculations.

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