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DIABETIC RETINOPATHY DETECTION USING RETINAL FUNDUS IMAGES

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ABSTRACT

Diabetic Retinopathy is known to be one of the leading causes of blindness and eye disease in working age population of developed world. This paper is an attempt towards finding an automated way to detect this disease in its early phase for precautions and to reduce future complications. In this paper we are using certain binarisation and segmentation technique to detect retinopathy using fundus images. Diabetic retinopathy screening incorporates separating of the retina into veins, optic circle and exudates. The acknowledgment of changes in vein structure in light of vessel narrowing and blockages in veins is of remarkable centrality. For this task we are implement various image processing techniques and filters to enhance many important features. The feature extraction is done by using SPHIT and SURF algorithm which are the assumed to be efficient techniques in the future era.

Keywords—Diabetic Retinopathy; Fundus Image; Digital Image Processing; Segmentation; Retina

I. INTRODUCTION

Diabetic Retinopathy is a known disease which is caused due to the disorder of the retinal vessels with patients having long term diabetes mellitus. It is an ocular manifestation of diabetes and around 80 percent of population having diabetes for more than 10 or more years has some stage of the disease. Diabetic retinopathy leads to visual impedance for about 4.8% of the 37 million patients throughout the world. According to the researches carried out 5% of total cases of blindness is caused due to DR. Diabetes is responsible for troubles like stroke, vision adversity and heart disillusionment. Diabetes impacts step by step the circulatory structure including the eye. The risk of vision impairment can be reduced on a very basic level by treatment of diabetic retinopathy. Retinal vein structure in retinal pictures has a basic part in area of diabetic retinopathy. There are a number of systems available for modified retinal vein division. A patient with diabetic retinopathy ailment needs to encounter prompt screening of retina. Hence, here we have proposed a strategy wherein an automated and sophisticated approach including image processing is used so that DR can be detected at early levels easily and damage to retina can be minimized.

Diabetic retinopathy is divided into several stages such as mild, moderate, severe and proliferative DR which are explained below:

(a) Mild non-proliferative retinopathy: Micro aneurysms, the small swellings in the tiny blood vessels of the retina will be formed in this stage. At least one of it will be present on retinal examination.

(b) Moderate non-proliferative retinopathy: Along with the progress of the disease blood vessels that nourish the retina are blocked. The cotton wool spots will be noticed during this stage.

(c) Severe non-proliferative retinopathy: Large number blood vessels are blocked, depriving several areas of the retina of their blood supply. The affected areas of the retina begin to show lack of oxygen and certain abnormalities like blot hemorrhages, bleeding of the veins and intra-retinal micro-vascular abnormalities.

(d) Proliferative diabetic retinopathy (PDR): Known as the advanced stage, the factors produced by the retina begins to trigger the growth of new blood vessels. These new blood vessels are abnormal and fragile. This is the extreme case of DR.

The disease/no disease automated grading system do provide benefits, but an additional objective is to develop a system capable of triaging images. This should include the ability to detect and prioritize DR images to ensure immediate attention and treatment.

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II. LITERATURE SURVEY

Sailee M Shendkar et al[1] used Image Processing algorithm in which Gabor Wavelet Transform is used for enhancing directional structures of vessels. Morphological Operation like opening is used to remove optic disk as we need to concentrate only on blood vessels and exudates. Discrete Wavelet Transform locates the exudates. M.U.Akram et al[4] The proposed method segmented the blood vessels using retinal images and multilayered thresholding like method for automated blood vessel segmentation. Deshmukh Prajakta et al[5] implemented two different methodologies to detect diabetic retinopathy using retinal fundus images. The first method used sobel operator and morphological operations like erosion and dilation. But the response of these operators turned out to be inefficient and needed post processing. Hence this methodology increased complexity. This was followed by anothermethod whichmade use of green channel which enhanced the retinal properties. Ganesh S et al[6] presented an automated system for Diabetic Retinopathy detection using Kirsch's edge detection algorithm. Kirsch template technique is used for the extraction blood vessels from retinal images. A.Alaimahal et al[7] proposed an algorithm which started with the pre-processing stage, which are used as guidelines for the subsequent Image enhancement and Micro aneurysms detection phases. This paper proposed a set of optimally adjusted morphological operators used for micro aneurysms detection. Akara Sopharak et al[8] made a paper based on the FCM clustering segmentation and morphological techniques. Four input features based on the characteristics of exudates, namely intensity, standard deviation, hue and number of edge pixels, are selected. Blood vessels and optic disc pixels are also removed from the fourth feature in order to prevent misclassification. Sheeba O et al[9] carried out segmentation of retinal vasculature by Gabor wavelet feature based kernel classifier (Support Vector Machine) and its use for detection of early symptoms of Diabetic Retinopathy. Performance evaluation was conducted using publicly available database with reference to the manually segmented images given in the database.

III. PROPOSED SYSTEM

The automatic detection of DR has received a lot of research attention year by year, with studies investigating micro aneurysms and hemorrhages and exudate detection. Each research from [1]-[8] shows us different ways to detect it at an early stage.

To overcome the drawbacks of literature survey we implemented four edge detection techniques (Canny, Sobel, Roberts, Prewitt) on our data set and found out that Canny edge detection method is the most efficient one. From our base paper we have found out that there are few complexities in Canny edge detection technique which we will reduce by using efficient algorithms namely SPIHT (Set Partition in Hierarchical Tree) and SURF (Speed Up Robust Feature).

IV. METHODOLOGY

I. Image Acquisition

Image is acquired from a medical retinal database, kaggle [3]. Dataset is taken from the challenge-data part. Data set consists of high resolution eye images and graded by trained professionals in 5 classes (0-4) which is according to below table and figure below that.

Class name	Meaning
Class 0	Normal Eye
Class 1	Mild DR eye
Class 2	Moderate DR Eye
Class 3	Severe DR eye
Class 4	Proliferative DR Eye

II. Image Binarisation

Image binarisation is done by using Otsu's method. It is used to automatically perform clustering-based image thresholding, or reduction of a grayscale image to a binary image. The algorithm assumes that the image contains two classes of pixels following bi-modal histogram, it then calculates the optimum threshold separating the two classes so that their combined spread is minimal.

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III. Segmentation

Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics. The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image.

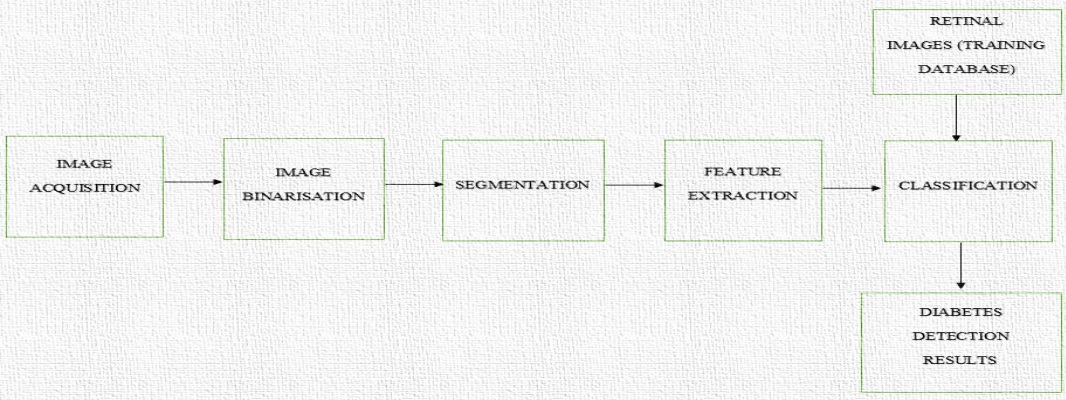
IV. Feature Extraction

Feature extraction is done using SPIHT and SURF algorithm. Set partitioning in hierarchical trees (SPIHT) is an image compression algorithm that exploits the inherent similarities across the sub bands in a wavelet decomposition of an image. The algorithm codes the most important wavelet transform coefficients first, and transmits the bits so that an increasingly refined copy of the original image can be obtained progressively. Speed up robust feature (SURF) is a patented local feature detector and descriptor, used for object recognition, image registration, classification or 3D reconstruction. It is used to track objects and extract points of interest. SURF uses a blob detector based on the matrix to find points of interest.

V. Classification

This is the final phase of the whole process. In this phase we examine the presence of exudates and finds out the DR stage of the person according to the results obtained from the eye images.

Fig: Block diagram of proposed methodology



VI. EXPERIMENTAL RESULTS

Fig: Fundus Image

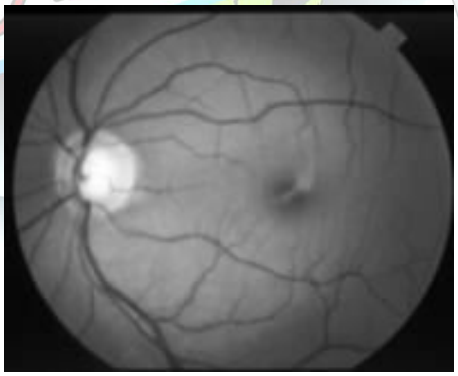


Fig: Grayscale Image

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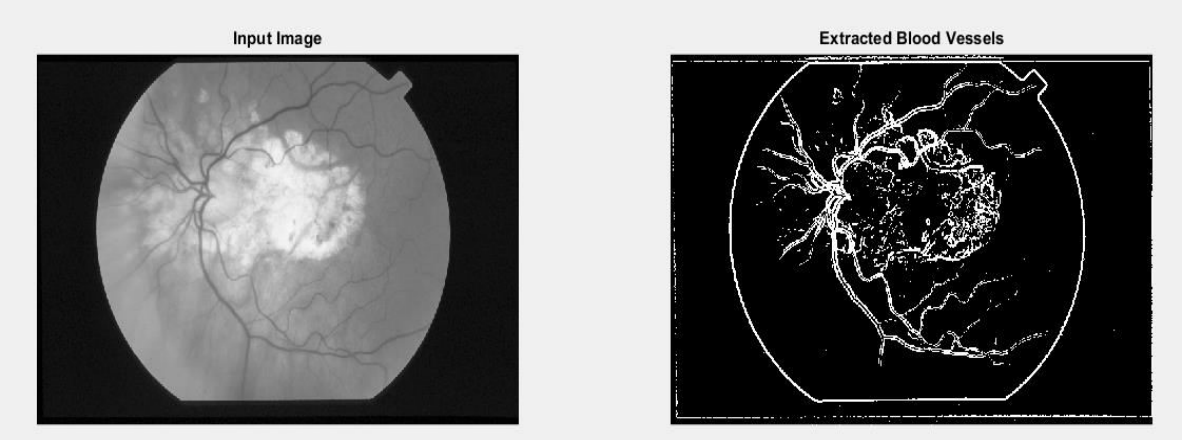

Fig: Blood-vessel Extraction

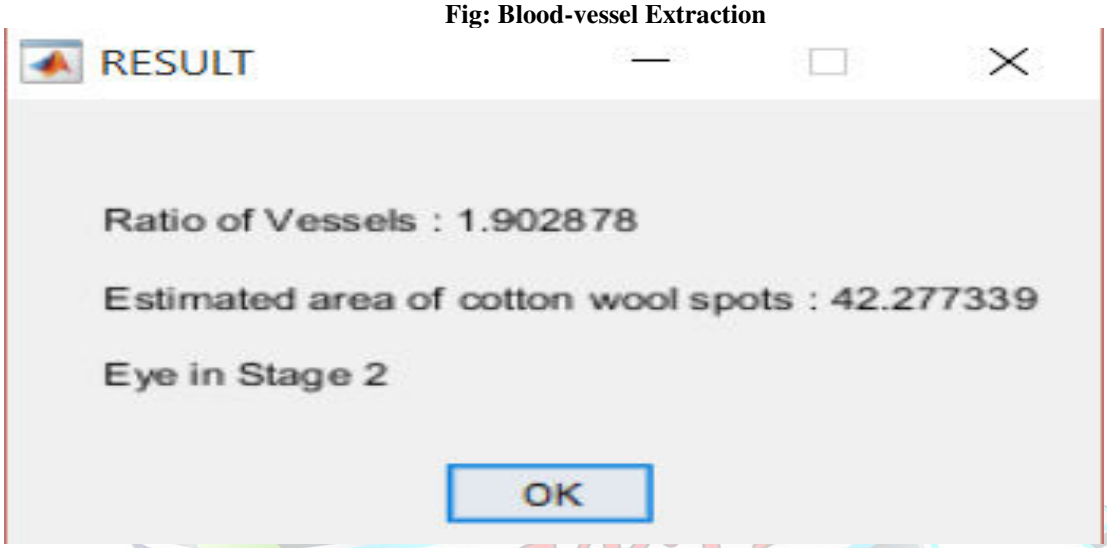

Fig: Stage Results

VII. DISCUSSION

We are proposing a method based on Canny edge detection method which differentiates between original diabetic image & processed image. This paper has demonstrated an automated system which is able to distinguish normal eye and the eye which is affected by the various stages of DR.. The main focus of this work is on segmenting the diabetic retinopathy image and classifying the Exudates, micro aneurysms and hemorrhages to give a clear picture of which stage the image belongs to. These methods give almost good results. We implemented the efficient algorithms like SHIFT and SURF for the process of feature extraction and to reduce few complexities. Thus Image processing techniques can reduce the work of ophthalmologists and the tools used automatically locate the exudates.

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