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RESEARCH ARTICLE

Automated Diagnosis of Retina Images for Diabetic Patients based on BP and SVM

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Abstract- Diabetic retinopathy is considered as the root cause of vision loss for diabetic patients and we should detect it early for effective treatment. The patient will become blind in extreme cases. The main stages of diabetic retinopathy are non-proliferative diabetes retinopathy (NPDR) and proliferative diabetic retinopathy (PDR). Neural Network plays an important role in a decision support system. In this project, an attempt has been made to make use of neural network tool (MATLAB) in the medical field. The main aim of project in medical diagnostics is to develop more cost effective and easy-to-use system, procedures and methods for supporting clinicians and to analyze the retinal images for important features of diabetic retinopathy using image processing techniques and an image classifier based on SVM which classify the images according to disease conditions.

Keywords: BP Neural network, Diabetic Retinopathy (DR), PDR, NPDR, SVM

I. INTRODUCTION

Diabetic has become one of the rapidly increasing health threats worldwide [1].Diabetes is a chronic diseases in which a person has high blood glucose (sugar), either because the body does not produce enough insulin, or because cells do not respond to the insulin that is produced [2].Diabetic retinopathy is an eye disease that can lead to partial or complete loss of visual capacity and one of the common complications of diabetes. The risk of the diseases increases with age and therefore, middle aged and older diabetics are prone to Diabetic retinopathy. Diabetic retinopathy is a critical eye disease which can be regarded as manifestation of diabetes on retina. In type 1 diabetes, the insulin production in the pancreas is permanently damaged, where as in type 2 diabetes, the person is suffering from increased resistance to insulin. The diabetes may cause abnormalities in the retina (diabetic retinopathy), kidneys (diabetic nephropathy) and nervous system (diabetic neuropathy)[8].The diabetes is also a major risk factor in cardiovascular diseases.[8].Diagnosis of diabetic retinopathy is usually conducted by the ophthalmologist by retinal images of patients. By using a Fundus camera, an ophthalmologist can obtain retinal images from patients diagnosed. This process is done manually by an ophthalmologist, it is very time consuming task. BP neural network has a sound theoretical system, a clear

algorithm flow, strong data identification and analog functions. In addressing the problem of nonlinear systems have obvious advantages, highlighting the enormous practical value.

II. Anatomy of Eye

The human eye is similar to a camera. Light that passes through the iris is focused onto the retina through a lens. There, the visual information is encoded and transmitted to the brain through the optical nerve. In fig.1 a cross section of the human eye is shown with the most important anatomy labeled. In this work the retina is the most important part of an eye. The specific changes caused by diabetic retinopathy can often be detected visually by examining the retina [4].

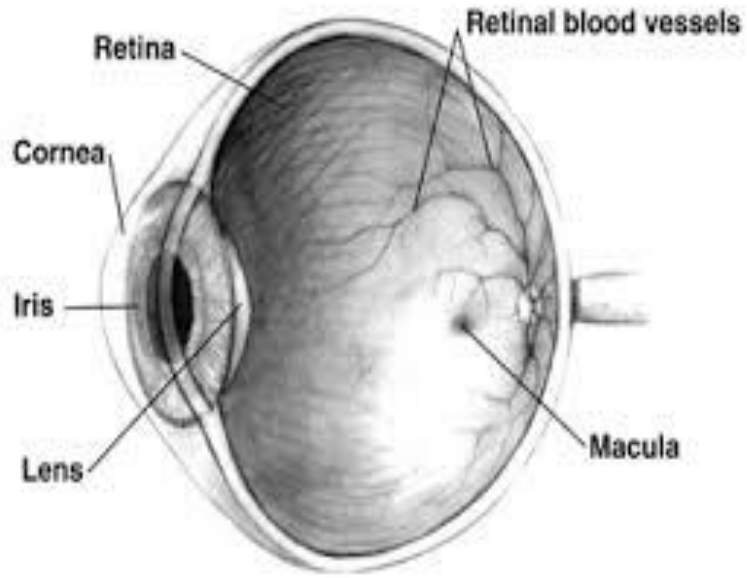

Fig: 1.Cross Sectional of the Right Human Eye

III. PROPOSED SYSTEM

Diabetic Retinal image used in the experiment is from DIARETDB0 (Standard Diabetic Retinopathy Database Calibration level 0). The main objective of the design is to define a testing protocol and database which can be used to benchmark diabetic retinopathy detection methods. All the images are captured with a digital fundus camera at a 50 degree field-of-view.

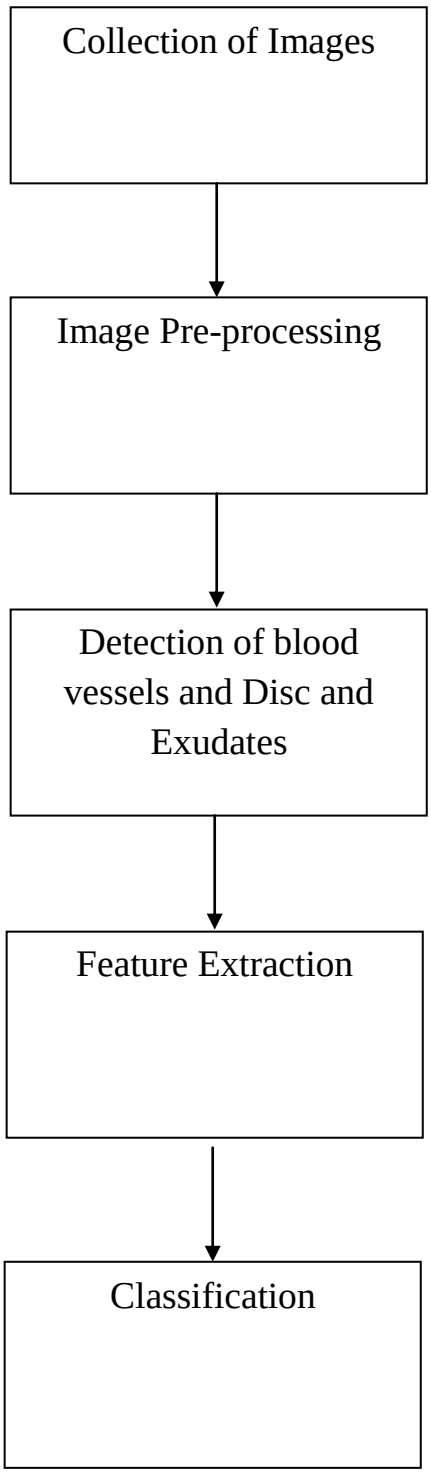

Fig: 2.Block Diagram of Proposed System

1) Collection of Diabetes Retina image

Diabetic Retinal image used in the experiment from DIARETDB0 (Standard Diabetic Retinopathy Database Calibration level 0).

2) Image Pre-processing

Pre-processing is the initial step in all case of image elated diagnosis system and it helps in accurate feature extraction which ultimately results in high classification accuracy. In case of Diabetic Retinopathy, the retinal images in the dataset are often noisy and poorly illuminated because of unknown noise and camera settings. Also the color of retina has wide variation from patient to patient. Thus to remove noise and undesired region the images are subjected to preprocessing steps. First fetch the values of Red, Green, and Blue (RGB) components.

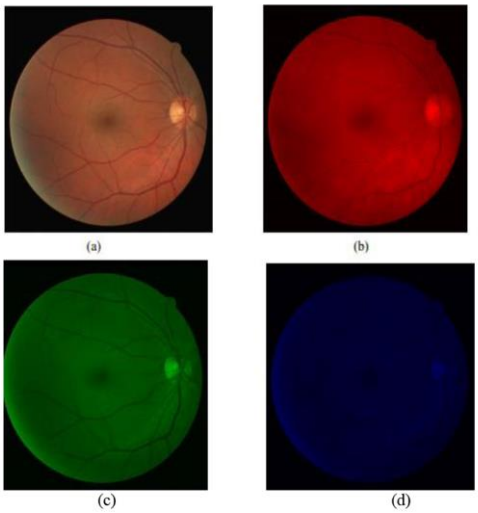

Fig: 3. a) Normal image b) Red, c) Green, d) Blue components. (Comparison of RGB components)

From the graph we can see that green channel image has a higher contrast between vessels and background while the red and blue ones tend to be more noise. So the following experiment is carried out on the green channel.

The Pre-Processing includes Histogram Equalization, Gaussian Filter, and Gray scale Invert. The Results are as follows.

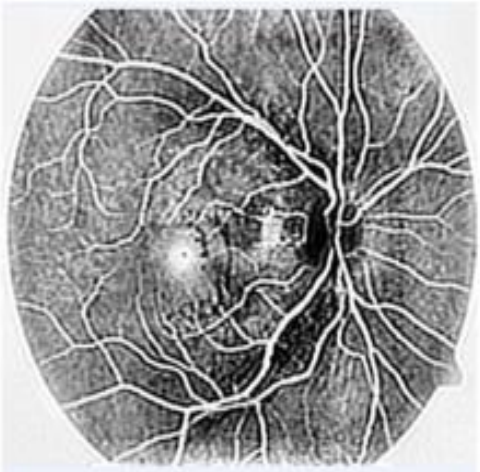

Fig: 4.Pre-Processing Image

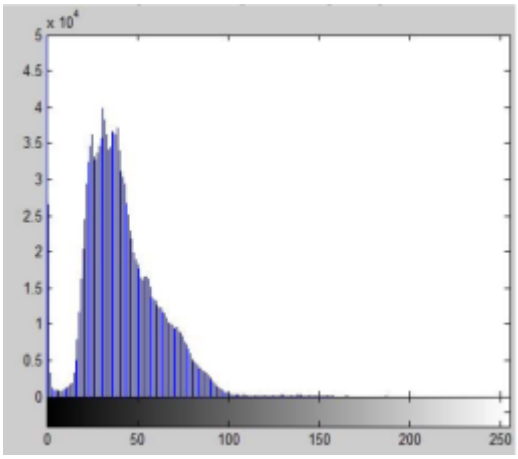

Fig: 5. Histogram of Green Channel

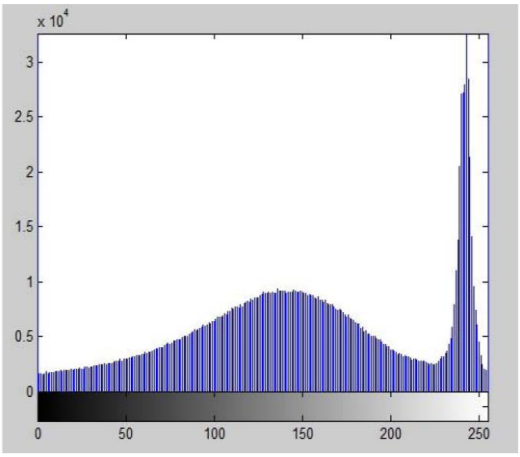

Fig: 6.Histogram Of the fig: 4

Contrast can also be found from the histogram, the histogram of the results more apparent contrast.

3) Detection of Blood Vessels and Optic Disc and Exudates.

Applying Canny Algorithm and Gradient Magnitude to Split the blood Vessels. The Results are as follows.

a) Blood Vessels Detection

Blood vessels are extracted for the identification of Diabetic retinopathy. The contrast of the fundus image tends to be bright in the center and diminish at the side, hence preprocessing is essential to minimize this effect and have uniform image. After which, the green channel of the image is applied with morphological image processing to remove the optical disk. Image segmentation is then performed to adjust the contrast intensity and small pixels considered to be noise are removed.

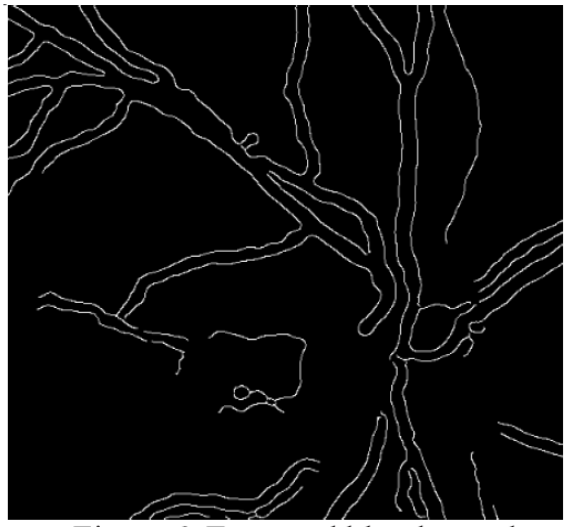

Fig: 7. Extracted Blood vessels.

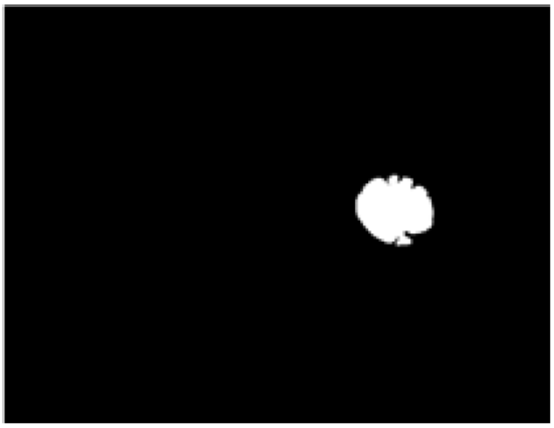

Fig: 8. Detected Optic Disc

b) Exudates Detection

Exudates appeared as bright yellow-white deposits on the retina due to the leakage of blood from abnormal vessels. Their shape and size will vary with the different retinopathy stages. The grayscale image is first preprocessed for uniformity before the morphological image processing is applied to remove the blood vessels and identify the exudates region. The exudates are detected after removing the border, optical disk.

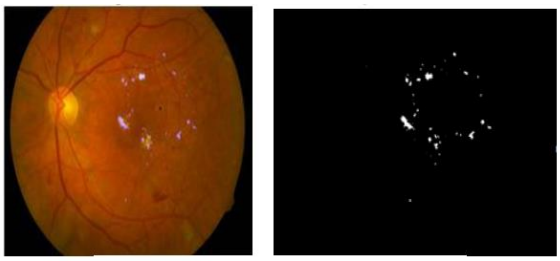

Fig: 9. Detected Exudates

IV. SVM Classifier

Support vector machine is a supervised learning process applied for analyzing the training data to find an optimal way to classify the diabetic retinopathy images into their respective classes namely PDR, NPDR or normal. SVM is a robust method used for data classification and regression. The SVM methods are described in detail by Vapnik [10]. SVM models constructs a hyper plane for separating the given data linearly into separate classes.(Fig 10 a) support vector machine method is used to distinguish between the various classes. The training process analyzes training data to find an optimal way to classify images into their respective classes.

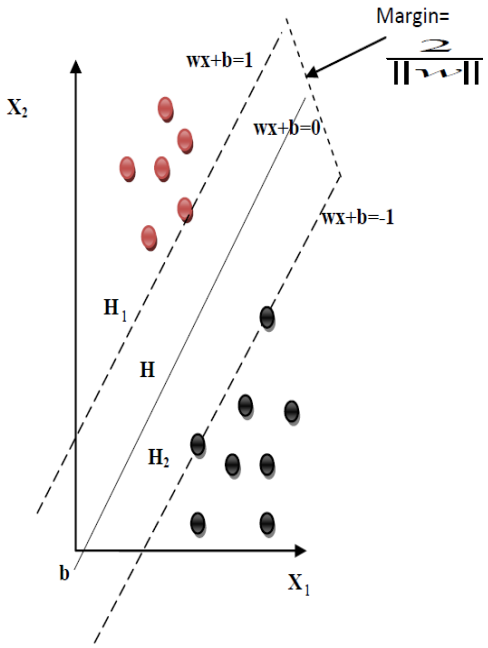

Fig 10 .a) Linear Classification

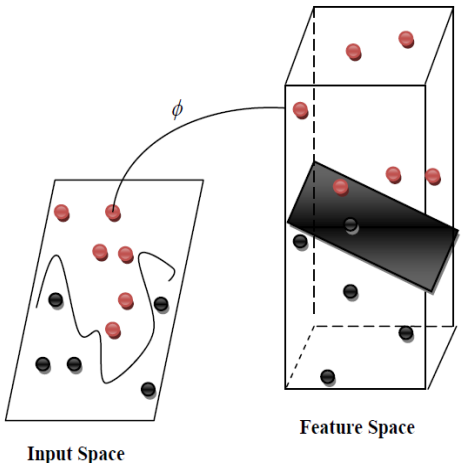

Fig 10.b) Nonlinear Classification

The training data should be sufficient to be statistically significant. The support vector machine algorithm is applied to produce the classification parameters according to calculated features. The derived classification parameters are used to classify the images. The image content can be discriminated into various categories in terms of designed support vector classifier. To fit nonlinear curves to the data, SVM make use of a Kernel function to map the data into a different space where a hyper plane can be used to do separation. SVM can be

applied to non-linear classification using non-linear kernel functions to map the input data onto a higher dimensional feature space in which the input data can be separated with the linear classifier (Fig 10.b).kernel function K(x,y) represents the inner product $<\phi(x),\phi(y)>$ in feature space. In this work, we have used polynomial kernel which is given by

$$k(x.x')=(x.x'+1)^d$$

Where x and x' are training vectors is the kernel parameter. The size of the input training vector is 250*6.the output can be one of the three categories namely PDR, NPDR, and Normal.

V. CONCLUSION

In the diagnosis of Diabetic Retinopathy, image processing of fundus images has a significant role to play. The input color retinal images are poor quality. So they were pre-processed using Histogram Equalization, Gaussian Filter. From The pre-processed images features were extracted for classification Process. As, an achievement of this work , the DR has been classified into three categories Normal, NPDR and PDR using BP and SVM.As the Speed of the Standard BP neural network weight adjustment is slow, the convergence rate is rather slow and easy to fall into local minimum, but SVM is more efficient than BP. Thus this work has given a successful Diabetic Retinopathy Diagnosing method which helps to diagnose the disease in early stage which mutually reduces the manual work.

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