Identification of Retinopathy Disease using Image Enhancement

Pydipala Laxmikanth, Bhramaramba Ravi

Abstract: Among the various after affects of prolonged diabetes Diabetic Retinopathy is one of the diseases that get triggered. The number patients with disease are increasing enormously and there methodologies need to be developed for early detection of the disease. The main cause for this disease is the high blood sugar levels which affects of the blood vessels of retina and there by leading towards blindness. Therefore in this article it reports a methodology based on linear discriminant analysis to combat the disease. The accuracy is estimated using precision and recall, linear discriminant analysis.

Index Terms: Diabetes retinopathy, linear discriminant analysis, retina, Blood pressure, and Diabetes mellitus

I. INTRODUCTION

The number of patients suffering with diabetic mellitus is increased exponentially across the globe. The main cause for this abnormal increase includes several factors like hereditary, damage of pituitary gland, Blood sugar levels, Dietary problems etc. These diseases are even noticed nowadays in young infants also. The diseases are graded into Type1, Type2. Type1 disease is generally considered due to the early onset of the disease. Type2 generally gets generated within the patients after middle ages. In either case the human body failed to supply the correct composition of insulin leading towards either insufficient insulin or abnormal supply of insulin. This imbalances cause the diseases such as the Diabetic Nephropathy, Diabetic Retinopathy, and Diabetic Neuropathy. Among the diseases that are prone due to insufficient insulin, in this article we considered the diabetic retinopathy disease. The abnormal increase of glucose levels may damage the blood vessels that pass the blood to the retina. This abnormal supply leads towards the blindness. It is sometimes considered to be a micro vascular impact. A patient who is tending to be a victim of the disease will never experience any significant symptom. Therefore it becomes a trickiest problem in identifying the disease before handling.

These are a costlier affair and most of the common people cannot effort such examination. Several phases of diabetic retinopathy are projected in the literature [1][2][3][4]. And most notable amount they include Non-proliferative retinopathy (NPDR) and proliferative retinopathy which are further divided into mild, moderate and severe. The second type of disease may be minimized because of blood flows near the valves. Therefore in this article a methodology is defined to identify the disease before hand in a much simplier way and with very minimum cost.

This article is presented as follows in section 2 , The major symptoms including complications and risks are presented, In section 3 database consider is presents the section 4 of the article deals with the feature extraction and brief note about TOP HAT FILTER together CANNY FILTER. The section 5 shows Results. The conclusion section 6 summarizes the Results.

II. MAJOR SYMPTOMS

Diabetic Retinopathy impacts the nervous system of the retina and thereby places a dominant role in making an individual blind. The two types of proliferative and Non-proliferative retinopathy. Among these two types the first type that is proliferative is more critical when compared the second type which is least influence. Many authors identified various symptoms which cause the blindness [5][6][7][8],[9] and some of the symptoms include :

> ➤ Changes in vision
> ➤ Difficulty in identifying color images.
> ➤ Difficulty in seeing during night.
> ➤ Out and out blindness

The complications of this disease include loss of eyesight falling down of retina and hemorrhage of blood cells in the eye region.

III. Data Set

In order to perform the experiment, in this paper, we have considered the DIARETDB1 which is the diabetic retinopathy standard Database. It can also be called as "calibration fundus images of level 1", which is used to compare the images and to measure the various diagnostic methods and their performances. By using the software application tools for image collections and image annotation with the experts having the work experience in medical lab technology and marked the independent images. This database having the total 200 fundus images of colored in which 5 images does not have any mark of diabetic retinopathy which are confirmed by the medical practitioner and remaining 185 having the signs of mild non proliferative diabetic retinopathy. The medical expert marks the hard and soft exudates and micro aneurysms and also the hemorrhages. The below is the source link for the dataset.
Source: http://www2.it.lut.fi/project/imageret/diaretdb1/

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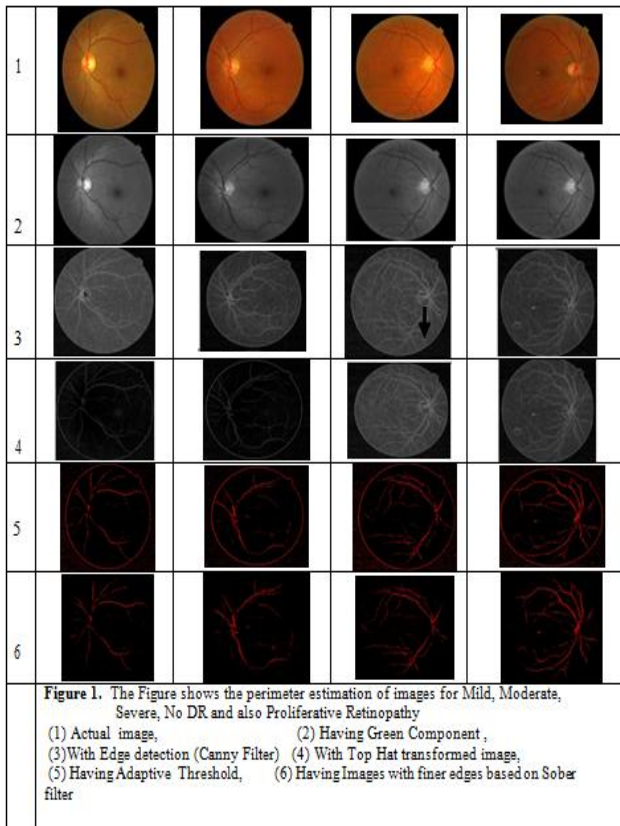
Figure 1. The Figure shows the perimeter estimation of images for Mild, Moderate, Severe, No DR and also Proliferative Retinopathy
(1) Actual image,   (2) Having Green Component,
(3) With Edge detection (Canny Filter) (4) With Top Hat transformed image,
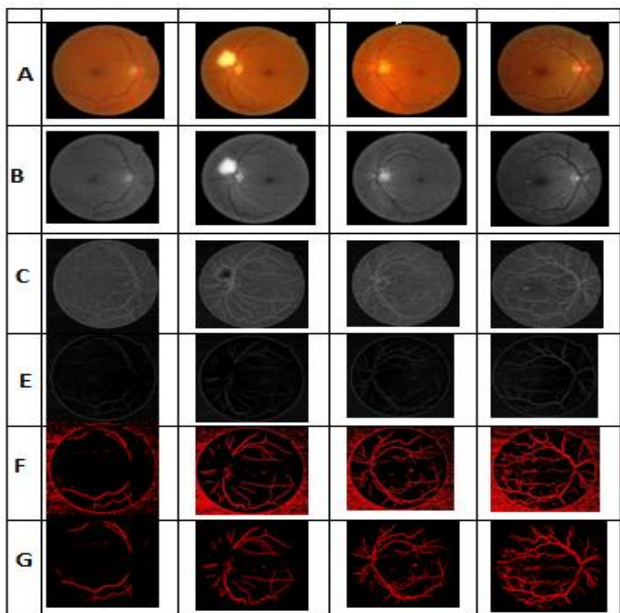(5) Having Adaptive Threshold,   (6) Having Images with finer edges based on Sober filter

Figure 2: The Figure shows the perimeter estimation of images for Mild, Moderate, Severe, No DR and also Proliferative Retinopathy (A) Actual image, (B) Having Green Component, (C)With Edge detection (Canny Filter) (E) With Top Hat transformed image, (F) Having Adaptive Threshold, (G) Having Images with finer edges based on sober filter

IV.   FEATURE EXTRACTION

The Retina Images of the above dataset are considered and by applying image clustering techniques together with Gray level Co- occurrence matrix (GLCM). The textual features are identified together with some statistical features Mean, Median, Third moment and Variance. In ordered to identify the most suitable features, that have low brightness levels, Top Hat Transformation is considered and it is given by the formula.

$$\text{Top hat (A, B)} = A-(A \circ B) = A-D\ (E\ (A, B), B)$$
… Equation (1)

The images are preprocessed using canny filter and the edges of the retinas are identified. In ordered to identify the missing edges and fill the holes morphological operation such as dilation, erosion, opening and closing [10][11][12][13] considered. The images extracted against the retina are in color and these images are converted into Grayscale using color inversion process of RGB to Grayscale conversion [14]. The LDA is used to find the relationships between the attributes and is computed by the formula:

$$L(Y) = A_1Y_1+A_2Y_2+ \ldots\ldots\ldots-+A_nY_n+A_0$$
… Equation (2)

Where L(Y) is the score of discriminant. A is the constant coefficient n= number of variables.

V.   Experimental Results

The Experimentation is carried out using SPSS tool and the relationships between the features are identified by using LDA given above. This description helps to identify the influence of the symptoms based on the score. The various symptoms considered are scaled between the range 0 to 1 and the classification details are given below:

Table 1.   The Classification Function Coefficients for Class Table Details

	0	1
BP_ Blood Pressure	0.108478	0.0945884
BMI_Body Mass Index	0.409923	0.488202
Preg_Pregnancies	0.257739	0.420364
DPF_DiabetesPedigreeFunction	2.585	3.39238
GL_Glucose	0.112536	0.150465
CONST_CONSTANT	-17.698	-25.3546

The Given function used for the first level of Class is

    -17.698+ 0.108478* BP_ Blood Pressure +
    0.409923* BMI_Body Mass Index +
    0.257739* Preg_Pregnancies + 2.585*
    DPF_DiabetesPedigreeFunction +
    0.112536* GL_Glucose
In ordered to predict the influence of the disease, the class observations are given below

Table 2. The Discriminant Function Coefficients for Class

	1
BP_ Blood Pressure	-0.184028

BMI_Body Mass Index	0.453982
Preg_Pregnancies	0.387413
DPF_DiabetesPedigreeFunction	0.224828
GL_Glucose	0.754234

Table 3. Unstandardized Coefficients

	1
BP_ Blood Pressure	-0.00946385
BMI_Body Mass Index	0.0578084
Preg_Pregnancies	0.12912
DPF_DiabetesPedigreeFunction	0.665673
GL_Glucose	0.02801343
CONST_CONSTANT	-5.35538

-0.184028* BP_ Blood Pressure + 0.453982* BMI_Body Mass Index + 0.387413* Preg_Pregnancies + 0.224828* DPF_DiabetesPedigreeFunction +0.754234* GL_Glucose

Basing on the above results the classification table is presented using Precision, Recall and Accuracy. The Results derived are tabulated below:

Table 4. Performance Measures

Classifiers	Accuracy	Precision	Recall
AdaBoost	61.11	61.13	68.54
GradientBoost	81.37	85.00	71.76
Random Forest	94.12	93.87	61.31
Proposed Classifier	93.12	95.54	95.76

Table 5. Result of Proposed Classifier

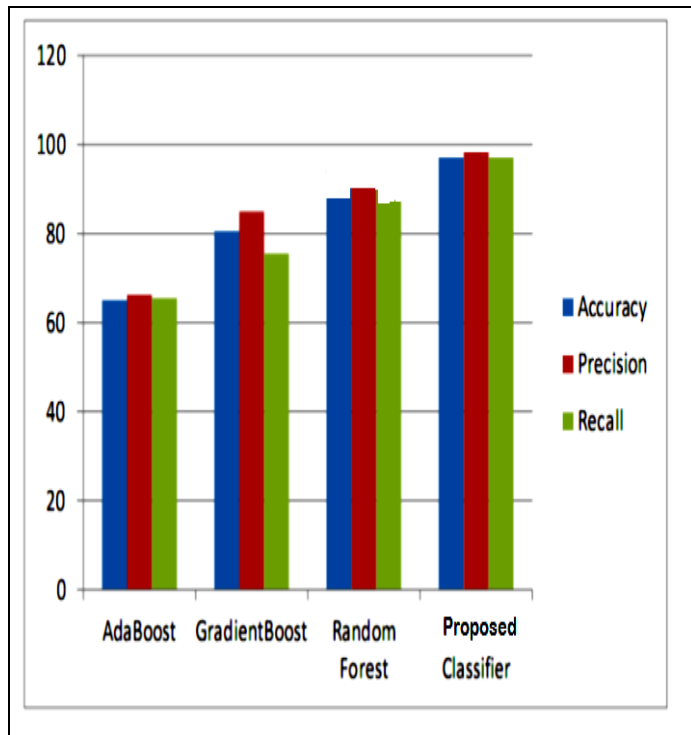| Class	Number of data for Training	Number of data for testing	Accurately classified	Accuracy
Normal	9	20	14	76.3%
NPDR	15	17	10	69.29%
PDR	38	18	16	90.51%

Figure 3: Graph showing the Comparative Analysis of proposed classifier with existing classifiers and their performance results w.r.t to Performance measures Precision, Recall and Accuracy.

V. CONCLUSION

In this article the methodology are developed to identify the most discriminant factor plays a significant role in the formation of disease. Based on these factors the impact of the coefficient such as BP_ Blood Pressure, BMI_Body Mass Index, Preg_Pregnancies, DPF_DiabetesPedigreeFunction and GL_Glucose can be identified. From the derived results it shows that the level of discriminant factor. The results are also derived using Precision, Recall, Accuracy. The experimentation is carried on 200 images taken from the dataset. The results show the accuracy of 90%. This clearly shows that the derived method is helping to identify the symptoms most significant.

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