Design and Development of Novel Technique for Diabetic Retinopathy Features Classification

[1]Sonali Gaikwad, [2]Jyotsna Gaikwad, [3]Ramesh Manza

[1]Vivekanand Institute of Advanced Studies in Management Science & Communications,

Aurangabad, India. sonalig.15@gmail.com

[2,3] Department of Computer Science and Information Technology, Dr. Babasaheb Ambedkar Marathwada University,

Aurangabad, India. [2]gaikwadjs@yahoo.co.in, [3]manzaramesh@gmail.com

Abstract— **Diabetic retinopathy occurs in people who have diabetes from last 8 to 10 years. It can damage the retina, the light-sensitive lining at the back of the eye. Diabetic retinopathy is a major sight-threatening snag of diabetes. The disease is considered by too much sugar in the blood, which can reason damage all through the body, including the eyes. DIARETDB0, DIARETDB1, STARE and DRIVE online fundus image database is taken, total 656 image. Diabetic retinopathy is categorized into four diseases such as abnormal blood vessels, hemorrhages, microaneurysms and exudates. After extraction of diabetic retinopathy features classification is performed. Proposed technique for identification of stage of diabetic retinopathy, means whether the extracted feature image is normal or abnormal. That we have classified with the help of proposed classification algorithm. Also principal component analysis and linear discriminant analysis is applied on extracted diabetic retinopathy features. For principal component analysis we got 94.80 % result and for linear discriminant analysis we got 93.13 % result.**

Keywords—component; formatting; style; styling; insert (key words)

I. INTRODUCTION

India has the 6.51 crore diabetes cases which is second highest number of diabetics in the world and is estimated to have 10.9 crore affected persons by 2035. The popularity of diabetes in the country is 9%. It is estimated that there are another 3.5 crore undiagnosed cases of diabetes in India. Non Communicable Diseases account for 0.98 crore deaths in the country and of all deaths 2% are due to diabetes per annum [1].

A. Types of Diabetes

There are two type of diabetes.

Type 1 diabetes (insulin dependent) is due to autoimmune mediated destruction of β - cells of the pancreas, resulting in absolute insulin deficiency [1].

Type 2 diabetes (non-insulin dependent) is characterized by insulin resistance and/ or abnormal insulin secretion. Type 2 diabetes accounts for over 90% and Type 1 accounts for up to 10% of all diabetes [1].

B. Eye Anatomy

The eye is our organ of vision. The eye has a number of modules which include but are not limited to the cornea, iris, pupil, lens, retina, macula, optic nerve, choroid and vitreous [2].

Following are the detail information about anatomy of eye.

Cornea: Clear front window of the eye that conveys and focuses light into the eye.

Iris: Colored part of the eye that helps regulate the amount of light that enters.

Pupil: Dark opening in the iris that regulates how much light is let into the eye.

Lens: Transparent configuration inside the eye that focuses light rays onto the retina.

Retina: Nerve layer that lines the back of the eye, senses light, and generates electrical impulses that travel through the optic nerve to the brain.

Macula: Minor central area in the retina that contains special light-sensitive cells and allows us to see fine details noticeably.

Optic nerve: Attaches the eye to the brain and transmits the electrical impulses formed by the retina to the visual cortex of the brain.

Vitreous: Clear, jelly-like matter that fills the middle of the eye [2].

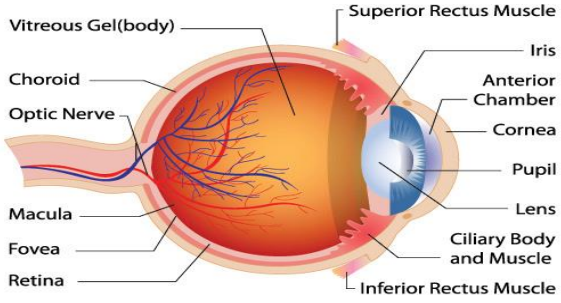

Figure 1: Anatomy of Eye

 DOI : 10.18231/2454-9150.2018.0869

C. *Diabetic Retinopathy (DR):*

Diabetic retinopathy damages retina. Retina is the inside layer at the back of eye that transforms light into images. If blood glucose level is get excessively high for longtime, it chunks off the small blood vessels that preserve the retina healthy. As condition gets worse, more blood vessels become choked. Scratch tissue shapes up because of all the new blood vessels eye has grown up. The extra pressure can cause retina to remove. These conditions can cause diabetic retinopathy, glaucoma, cataract and other problems that may result as blindness [3].

D. *Diabetic Retinopathy Diseases:*

Diabetic retinopathy is having four diseases such as abnormal blood vessels, hemorrhages, microaneurysms and exudates.

a. *Abnormal Blood Vessesls:*

An important symptom for diabetic retinopathy is abnormally extensive veins leading to a remarkably low ratio of the average diameter of arteries to veins. There are also additional diseases such as high blood pressure or diseases of the pancreas with one sign being an abnormal average diameter of arteries to veins value [4].

b. *Hemorrhages:*

The foremost cause of diabetic retinopathy is diabetes, also by hypertension. The asymmetrical flow of the blood from the vessels into the retina can cause to hemorrhages. Diabetic retinopathy can causes blindness. The primary stage detection of diabetic retinopathy can be helped with the presence of hemorrhages [5].

c. *Microaneurysms:*

Diabetic retinopathy categorized into two type's non-proliferative and proliferative diabetic retinopathy. The first symptom of diabetic retinopathy is microaneurysms. Color of microaneurysms is red and its size variations between 10 and 100 µm. To avoid diabetic patients from vision loss or blindness, microaneurysms detection is essential [6].

d. *Exudates:*

Exudates is a fatty deposits on the retina which look like yellowish regions in fundus image. Fundus images show substantial difference in brightness [7].

II. METHODOLOGY

A. *Using Neural Network*

For detection of diabetic retinopathy diseases we use digital image processing, diabetic retinopathy categorized in four lesions such as abnormal blood vessels, hemorrhages, microaneurysms, and exudates. Following are the workflow for the proposed algorithm.

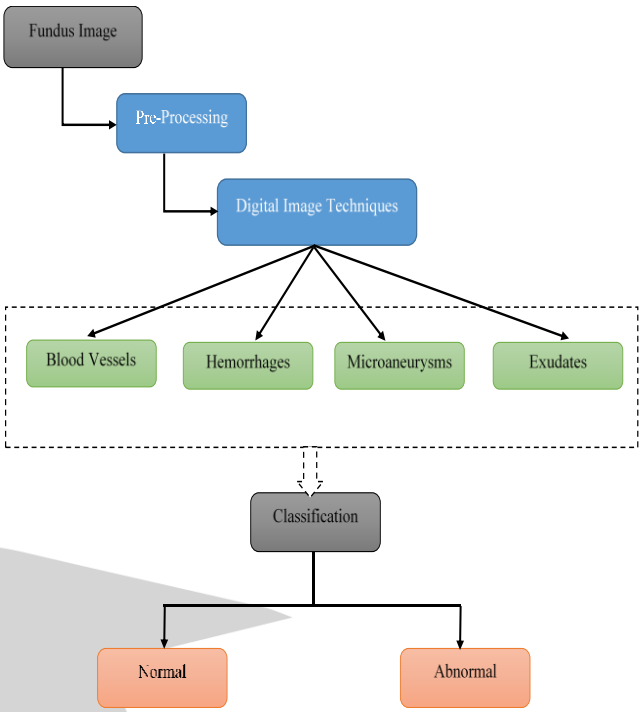

Figure 3: Workflow for Extraction of Diabetic Retinopathy Diseases

For extraction of diabetic retinopathy diseases we used, digital image processing techniques such as, green channel separation, histogram equalization, image complement function and so on. We have extracted abnormal blood vessels, hemorrhages, microaneurysms and exudates. On the basis of extracted features, we have classify the image into normal and abnormal with the help of different classification techniques.

III. RESULT

We have extracted the diabetic retinopathy lesions such as, blood vessels abnormality, hemorrhages, microaneurysms and exudates. For classification of diabetic retinopathy disease, we have calculated the area of blood vessels, area of hemorrhages, area of microaneurysms and area of exudates. If area of blood vessels is greater than 95 then vessel is abnormal. Same for hemorrhages, microaneurysms and exudates. Following table shows the features of diabetic retinopathy lesions.

Table 1: Diabetic Retinopathy features

Sr. No.	Blood Vessels	Hemor-hhages	Microaneurysms	Exudates
1	21562	322993	986	0
2	26023	283949	1475	0
3	24070	329914	635	0
4	24954	340914	1328	287
5	24422	334232	984	603
6	28172	289186	1653	634
7	19051	413067	810	1137
8	35140	334249	1219	2527

DOI : 10.18231/2454-9150.2018.0869

9	38909	321811	1515	97
10	26085	326571	795	976
11	19581	298395	1301	314
12	15550	338304	760	0
13	38666	289635	1006	903
14	21699	616148	562	0
15	15158	916541	282	102
16	21013	634137	638	159
17	19469	674713	753	757
18	15057	648298	282	0
19	20455	350739	747	1332
20	23762	312532	1303	1351
21	22676	318665	1364	530
22	31851	399856	982	354
23	27719	311194	950	2571
24	21562	315108	1360	0
25	26023	461082	760	46
26	24070	466351	653	0
27	24954	306549	1307	2113
28	24422	288630	1330	0
29	28172	398304	224	0
30	19051	315403	1072	203

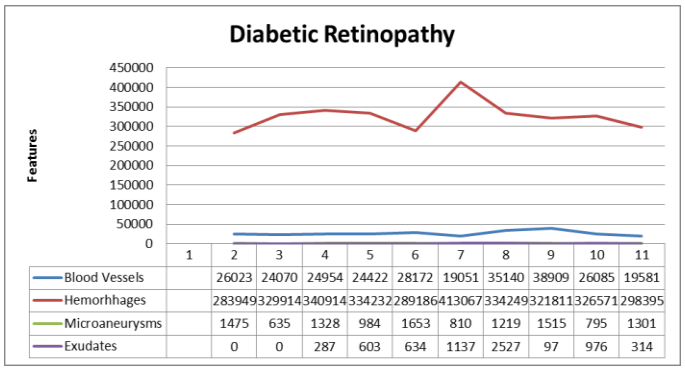

Figure 4: Result

After classification of diabetic retinopathy lesions, we applied the classification techniques (PCA and LDA). Principal component analysis is a method used to highlight variation and take out strong patterns in a dataset. PCA frequently used to make data informal to explore and visualize. Following is the output of PCA, applied on the extracted diabetic retinopathy features. PCA achieves the 94.80% accuracy.

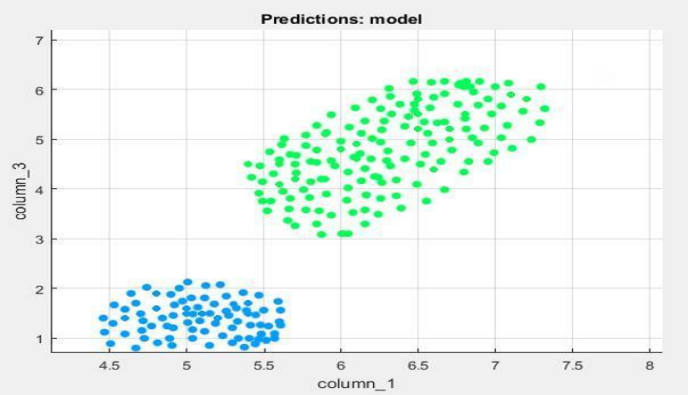

Figure 5: Principal Component Analysis

Linear discriminant analysis is a simplification of Fisher's linear discriminant, a method used to find a linear grouping of diabetic retinopathy features that characterizes or divides two or more classes of objects. The subsequent grouping may be used as a linear classifier. Following is the output of LDA for diabetic retinopathy features and it achieves 93.13% accuracy.

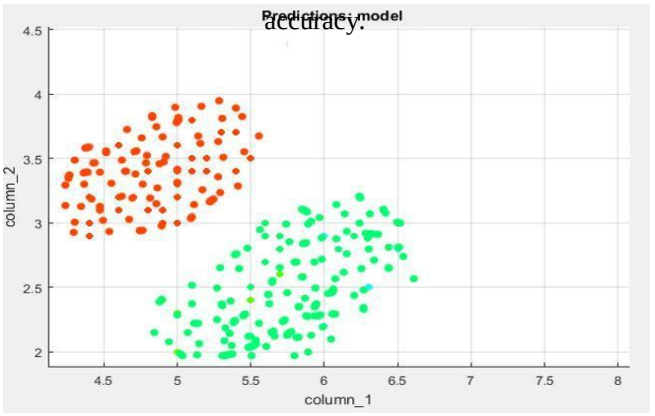

Figure 6: Linear Discriminant Analysis

IV. CONCLUSION

Diabetic retinopathy occurs in people who have diabetes from last 8 to 10 years. It can damage the retina, the light-sensitive lining at the back of the eye. Diabetic retinopathy is a major sight-threatening snag of diabetes. The disease is considered by too much sugar in the blood, which can reason damage all through the body, including the eyes. DIARETDB0, DIARETDB1, STARE and DRIVE online fundus image database is taken, total 656 image. Diabetic retinopathy is categorized into four diseases such as abnormal blood vessels, hemorrhages, microaneurysms and exudates. After extraction of diabetic retinopathy features classification is performed. Proposed algorithm is designed for classification of diabetic retinopathy, means whether the extracted feature image is normal or abnormal. Also principal component analysis and linear discriminant analysis is applied on extracted diabetic retinopathy features. For principal component analysis we got 94.80 % result and for linear discriminant analysis we got 93.13 % result. Overall proposed algorithm got 94.34 % result for classification of diabetic retinopathy.

 DOI : 10.18231/2454-9150.2018.0869

REFERENCES

[1] (Diabetic Retinopathy) http: // www.ncdc.gov.in / writereaddata / linkimages / cdalert0616262925183.pdf (Access date: 21-11-2018).

[2] (Anatomy of Eye) https: // www.medicinenet.com / image-collection / eye_anatomy_detail_picture / picture.htm (Access Date: 22-11-2018).

[3] (Diabetic Retinopathy) https://www.webmd.com/diabetes/diabetic-retinopathy#1 (Access Date: 10-09-2018).

[4] Claudia Kondermann, Daniel Kondermann and Michelle Yan, “Blood vessel classification into arteries and veins in retinal images”, Proceedings Volume 6512, Medical Imaging 2007: Image Processing; 651247, DOI: 10.1117/12.708469, 2007.

[5] N. Kaur, S. Chatterjee, M. Acharyya, J. Kaur, N. Kapoor and S. Gupta, "A supervised approach for automated detection of hemorrhages in retinal fundus images," 2016 5th International Conference on Wireless Networks and Embedded Systems (WECON), Rajpura, pp. 1-5, DIO: 10.1109/WECON.2016.7993461, 2016.

[6] Şehirli Eftal, Turan Muhammed and Dietzel Alexander, “Automatic Detection of Microaneurysms in RGB Retinal Fundus Images”, International Journal of Scientific and Technological Research, Volume 1, Issue 8, ISSN No: 2422-8702 1. 1-8, 2015.

[7] P. N. Sharath Kumar, R. R. Kumar, A. Sathar and V. Sahasranamam, "Automatic detection of exudates in retinal images using histogram analysis," 2013 IEEE Recent Advances in Intelligent Computational Systems (RAICS), Trivandrum, 2013, pp. 277-281, DOI: 10.1109/RAICS.2013.6745487, 2013.

 DOI : 10.18231/2454-9150.2018.0869