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Disease analysis system using Content Based Image Retrieval

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Abstract— One of the common causes of blindness is Diabetic retinopathy. This disease threatens the visions of a lot of people affected with diabetes in the world. This is an important eye disease that may lead to blindness or may blur the visions.
In this work, an attempt has been made to examine retinal images for Content Based Image Retrieval (CBIR) application. Various fundus photographs are collected and given as input for further examination. Based on the anatomical structure and feature of the retinal images we classify the type of diseases in the retina. In this work, an Efficient Fuzzy Neural Network (FNN) is proposed to eliminate the iteration dependent nature of the classification system. This disease identification system includes segmentation from retinal images, feature extraction process followed by image classification. Experimental results show promising possibilities for the proposed CBIR based systems in terms of performance measures.

Keywords—Diabetic retinopathy, Content Based Image Retrieval, Fuzzy Neural Network.

I. INTRODUCTION

A common disease, in which the secretion of the pancreas lowers and proper quantity of insulin is not secreted is known as Diabetes. This hormone is significant for maintaining proper blood sugar level. Therefore, people who are affected with this disease have increased blood sugar levels. Patients who suffer from diabetes for a period of more than twenty years get affected by a disease called Diabetic Retinopathy (DR), which thrashes the retina. Researches show that when diabetic retinopathy is screened, the risk of blindness can be reduced by 50%. Thus, detecting the disease early could limit its severity and help in treating it more efficiently. The detection of exudates, optic disc and blood vessels are important steps in identifying the type of disease. Detecting the exudates manually is tedious as ophthalmologists have to spend so much of time for analysing and diagnosing the retinal images. Cost, time and work done can be saved to a great extent by using automated screening techniques for exudates detection. Extraction of the location, size and severity grade of exudates in the retinal images can be done by image processing techniques [1]. The elliptical shape in the eye fundus image is the Optical disc. Different people may have different sizes of optical disc. It may vary between one-tenth and one-fifth of the image. The bright yellowish region in a colour fundus image is known as the exudates. The optic disc is the usual feature in the fundus image, but the exudates are the unusual case. Optic disc and the blood vessels are the usual features of the image and so the detection of blood vessels is as important as the detection of the optical disc [2]. The outward show of blood vessel in a retinal image looks complex and has low contrast and hence manual discovery of blood vessels is complicated [3].

II. RELATED WORK

1. AUTOMATIC DETECTION OF EXUDATES IN RETINAL IMAGES USING A SPLIT- AND-MERGE ALGORITHM [1]

In this work, the performance results indicate that very competitive results in exudates detection can be given by automated processing methods that are based on split-and-merge algorithm.

2. AUTOMATIC DETECTION OF OPTIC DISC AND BLOOD VESSELS FROM RETINAL IMAGES USING IMAGE PROCESSING TECHNIQUES [2]

Detection of optic disc and detection of the blood vessels play a major role in the screening of eye diseases. Screening of diabetic retinopathy, glaucoma and so on can be done by using the results of this work and this can be used in the future for other processes.

3. ON THE DETECTION OF RETINAL VESSELS IN FUNDUS IMAGES [3]

Detection of blood vessel structure in retinal fundus images can be made accurately and effectively by segmentation of the core of the blood vessel. In these types of scanning approaches, the whole image is searched throughout for possible feature pixels as they usually provide complete segmentation of the blood vessels in the image.

4. RETINAL BLOOD VESSEL SEGMENTATION ALGORITHM FOR DIABETIC RETINOPATHY AND ABNORMALITY DETECTION USING IMAGE SUBSTRACTION [4]

The presence of diabetic retinopathy on fundus images taken by the using the medical imaging camera by medical personnel in the hospital is determined by this work. This technique has been tested on a number of fundus images. Clearer and more accurate output for ophthalmologists and automated retinal image diagnosis is given by this method. A high sensitivity and specificity is demonstrated in the proposed system.

5. DETECTION OF DIABETIC RETINOPATHY IN FUNDUS
PHOTOGRAPHS [5]

This work demonstrates the overview of major image processing components which are required to build an automated system for the detection of diabetic retinopathy.

6. A CONTRIBUTION OF IMAGE PROCESSING TO THE DIAGNOSIS OF DIABETIC RETINOPATHY—DETECTION OF EXUDATES IN COLOR FUNDUS IMAGES OF THE HUMAN RETINA [6]

This paper presents efficient algorithms for the detection of the optic disc and retinal exudates. This also evaluates robustness and accuracy in comparison to human graders on a small image database.

7. AUTOMATIC DETECTION OF EXUDATES IN RETINAL FUNDUS IMAGES USING DIFFERENTIAL MORPHOLOGICAL PROFILE [7]

The exudates are detected efficiently and accurately by the proposed method. This method outperforms when compared with other state of the art methods.

8. SVM AND NEURAL NETWORK BASED DIAGNOSIS OF DIABETIC RETINOPATHY [8]

In this work, the DR has been classified into two categories, Non Proliferative Diabetic Retinopathy and Proliferative Diabetic Retinopathy using PNN and SVM. SVM is more efficient than PNN from the obtained results. This reduces the manual work.

9. A STUDY ON DIFFERENT IMAGE RETRIEVAL TECHNIQUES IN IMAGE PROCESSING [9]

In this work, various image retrieval techniques based on color, texture, and shape and semantic are compared. When semantics based image retrieval is used, better retrieval results are obtained and performance factor increases.

10. MULTI DISEASE ANALYSIS SYSTEM USING CONTENT BASED IMAGE RETRIEVAL [10]

In this paper, the method of content based image retrieval is used to detect diseases in DICOM format images.

11. CONTENT BASED IMAGE RETRIEVAL (CBIR) SYSTEM FOR DIAGNOSIS OF BLOOD RELATED DISEASES [11]

Digital images of blood samples are taken and using content based image retrieval, automatic diagnosis of three diseases, namely Leukemia, Malaria and Sickle cell Anemia is done.

12. SURVEY ON CANCER DETECTION USING CONTENT BASED
IMAGE RETRIEVAL TECHNIQUE [12]

A survey of various techniques for detection of cancer using Content Based Image Retrieval has been made in this paper.

III. PROPOSED SYSTEM

In this proposed CBIR based framework, the best method to obtain perfect contrast in analyzing the diseases affected surface of the CBIR retinal images is image enhancing methods. There are two different methods considered to implement this which include Histogram Equalization (HE) and Contrast Limited Adaptive Histogram Equalization (CLAHE). The detection of retinal blood vessel is done by curvelet transform. The detection of exudates is carried out by using various morphological operators. Analysis of Statistical texture is dependent on Gray Level Co-occurrence Matrix (GLCM).The feature vectors which are used for detection of retinal diseases consists of seven features which are the results from retinal structure segmentation and texture analysis. In this work, a Fuzzy Neural Network (FNN) is proposed for retinal image classification which is highly efficient for detection of the retinal diseases based on the extracted features of the CBIR retinal images.

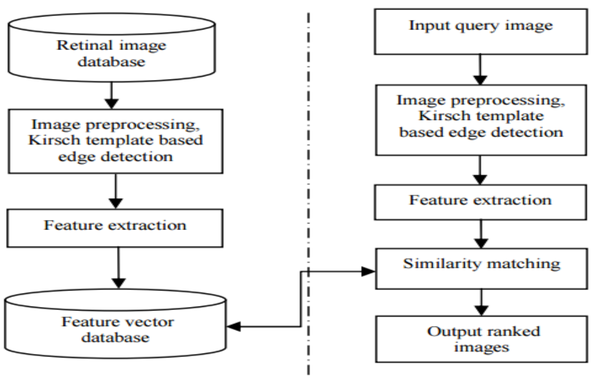

Fig 1: Content Based Image Retrieval Architecture

The following diagram shows the implementation process discussed in this paper.

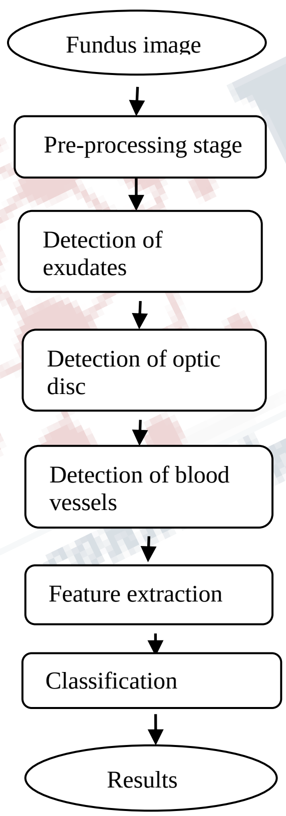

Fig 2: Data Flow Diagram

Nowadays, several image retrieval algorithms are developed to find solutions for various problems relating to images in a database. In this paper, a method is proposed to determine the type of disease in the retina. Four diseases, namely Cataracts, Glaucoma, Rubeosis iridis, Ocular nerve palsies are being identified in this work. This is done by using methods of segmentation, feature extraction and classification. Segmentation of exudates and optical disc is done by using morphological operations such as erosion, dilation, opening and closing.

Steps for detection of exudates with various techniques are as follows:

1. From the coloured fundus image, using some built in functions, initially the extraction of the green channel is done.
2. The background image is removed from the original image by using morphological reconstruction.
3. The next step involves applying Kirsch's edges. It helps in capturing the edges of the exudates. A kernel value K is calculated at 8 different directions on the image which gives the edge detector.
4. The outputs of the kernel are combined together by selection of a value found on each pixel output which is maximum.
5. All the connected components are then removed from the binary image such that the resultant binary image contains only the optical disc. It is subtracted from the threshold image and thus an image is delivered containing the exudates. This can be done for blood vessels as well.

Feature extraction is done based on Gray Level Co-occurrence Matrix (GLCM). It denotes the occurrence of various combinations of grey level pixels in the image. The feature vector used for detection of retinal diseases consists of seven features obtained from segmentation of retinal structures and texture analysis. These features include the area of blood vessels, area of exudates, area of Micro Aneurysms (MA), contrast, homogeneity, correlation and energy.

In this work, classification based on the extracted features is done by using FNN classifier. The architecture used for this network is a single coated structure with the number of input layer neurons corresponding to the size of the input feature set, and the number of output layer neurons which corresponds to the number of output classes. Here the fuzzy values are taken as calculating outputs in FNN.

IV. EXPERIMENTAL RESULTS

The fundus images of the eye are collected. The dataset collected is trained and the extracted values are stored in

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the database after the processes mentioned above. The tool used in this paper for implementation is Matlab.

A data analysis and visualization tool which has been intended with powerful support for matrices and matrix operations is Matlab. Matlab also has excellent graphics capabilities, and its own well-built programming language. It has various built-in functions for image processing.

In this paper, an efficient disease analysis technique has been presented for the detection of disease in the retina, when a fundus image is given as input. The feature vector of segmented image is extracted and stored in the feature vector database. The same is repeated in the query image. Classification based on the extracted feature vector values is performed by FNN classifier. Finally the disease in the retinal fundus image is identified.

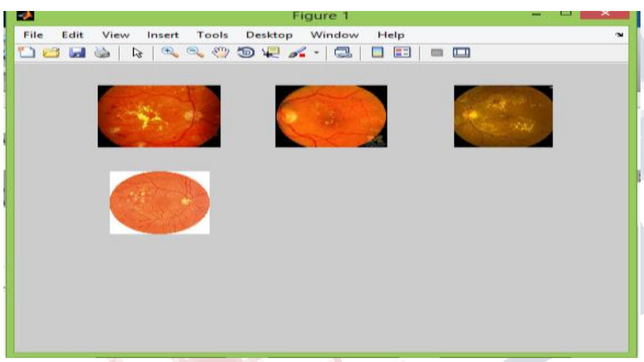

Fig 3: Query image

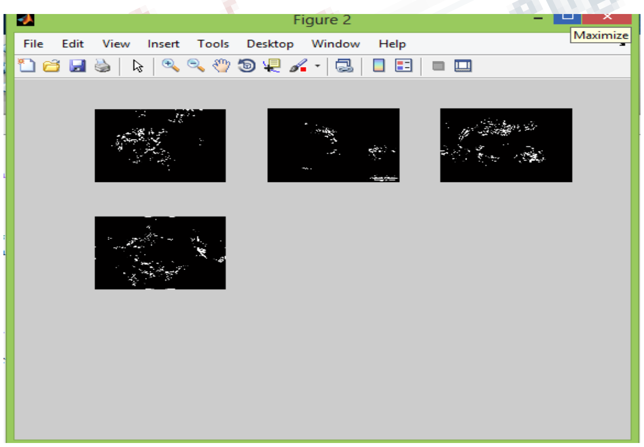

Fig 4: Extraction of exudates

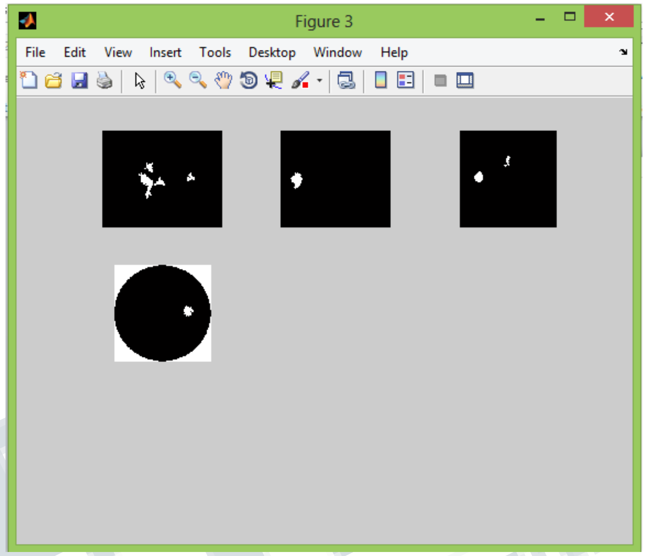

Fig 5:Extraction of optical disk

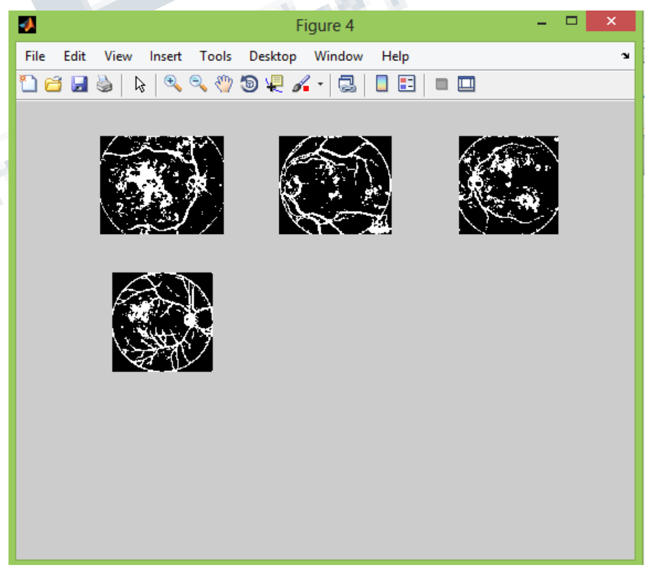

Fig 6: Extraction of blood vessels

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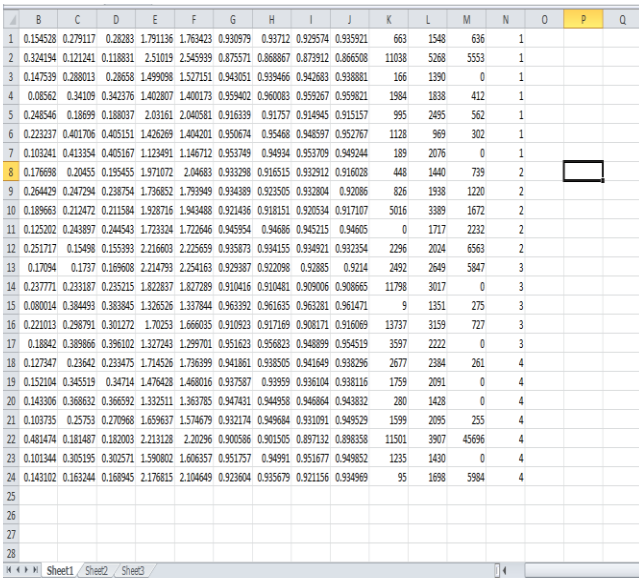

	B	C	D	E	F	G	H	I	J	K	L	M	N
1	0.154528	0.279117	0.28283	1.791136	1.763423	0.930979	0.93712	0.929574	0.935921	663	1548	636	1
2	0.324194	0.121241	0.118831	2.51019	2.545939	0.875571	0.868867	0.873912	0.866508	11038	5268	5553	1
3	0.147539	0.288013	0.28658	1.499098	1.527151	0.943051	0.939466	0.942683	0.938881	166	1390	0	1
4	0.08562	0.34109	0.342376	1.402807	1.400173	0.959402	0.960083	0.959267	0.959821	1984	1838	412	1
5	0.248546	0.18699	0.188037	2.03161	2.040581	0.916339	0.91757	0.914945	0.915157	995	2495	562	1
6	0.223237	0.401706	0.405151	1.426269	1.404201	0.950674	0.95468	0.948597	0.952767	1128	969	302	1
7	0.103241	0.413354	0.405167	1.123491	1.146712	0.953749	0.94934	0.953709	0.949244	189	2076	0	1
8	0.176698	0.20455	0.195455	1.971072	2.04683	0.933298	0.916515	0.932912	0.916028	448	1440	739	2
9	0.264429	0.247294	0.238754	1.736852	1.793949	0.934389	0.923505	0.932804	0.92086	826	1938	1220	2
10	0.189663	0.212472	0.211584	1.928716	1.943488	0.921436	0.918151	0.920534	0.917107	5016	3389	1672	2
11	0.125202	0.243897	0.244543	1.723324	1.722646	0.945954	0.94686	0.945215	0.94605	0	1717	2232	2
12	0.251717	0.15498	0.155393	2.216603	2.225659	0.935873	0.934155	0.934921	0.932354	2296	2024	6563	2
13	0.17094	0.1737	0.169608	2.214793	2.254163	0.929387	0.922098	0.92885	0.9214	2492	2649	5847	3
14	0.237771	0.233187	0.235215	1.822837	1.827289	0.910416	0.910481	0.909006	0.908665	11798	3017	0	3
15	0.080014	0.384493	0.383845	1.326526	1.337844	0.963392	0.961635	0.963281	0.961471	9	1351	275	3
16	0.221013	0.298791	0.301272	1.70253	1.666035	0.910923	0.917169	0.908171	0.916069	13737	3159	727	3
17	0.18842	0.389866	0.396102	1.327243	1.299701	0.951623	0.956823	0.948899	0.954519	3597	2222	0	3
18	0.127347	0.23642	0.233475	1.714526	1.736399	0.941861	0.938505	0.941649	0.938296	2677	2384	261	4
19	0.152104	0.345519	0.34714	1.476428	1.468016	0.937587	0.93959	0.936104	0.938116	1759	2091	0	4
20	0.143306	0.368632	0.366592	1.332511	1.363785	0.947431	0.944958	0.946864	0.943832	280	1428	0	4
21	0.103735	0.25753	0.270968	1.659637	1.574679	0.932174	0.949684	0.931091	0.949529	1599	2095	255	4
22	0.481474	0.181487	0.182003	2.213128	2.20296	0.900586	0.901505	0.897132	0.898358	11501	3907	45696	4
23	0.101344	0.305195	0.302571	1.590802	1.606357	0.951757	0.94991	0.951677	0.949852	1235	1430	0	4
24	0.143102	0.163244	0.168945	2.176815	2.104649	0.923604	0.935679	0.921156	0.934969	95	1698	5984	4

Fig 7: Feature extracted values

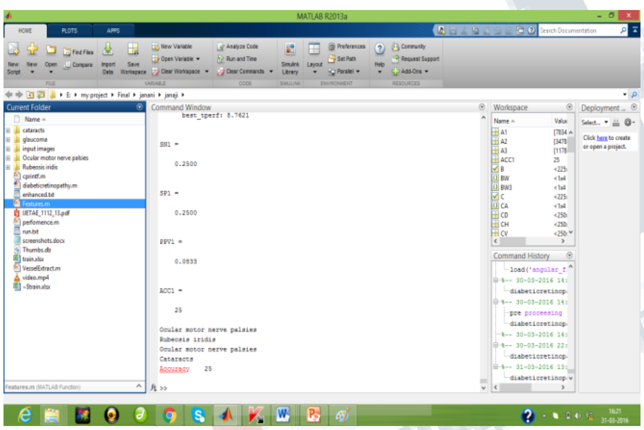

Fig 8: Output

V. CONCLUSIONS

In this work, we have developed a disease detection system that includes anatomical structure segmentation from retinal images which is followed by image classification using the CBIR imaging system. This CBIR based imaging for disease detection system also involves feature extraction techniques which significantly enhance the efficiency of the proposed Fuzzy Neural Network (FNN). According to the experimental results, the proposed method of FNN classification is more efficient for disease detection based on CBIR imaging than the existing conventional Kohonen Neural Network.

The developed disease detection system is to analyze the retinal images and detect the type of disease. In the future, this can be enhanced in such a way that disease identification can be done for various parts of the body such as heart, lungs, etc. Accuracy level can be improved by increasing the number of images trained and stored in the database.

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