International Journal of Electrical Electronics & Computer Science Engineering
Volume 5, Issue 1 (February, 2018) | E-ISSN : 2348-2273 | P-ISSN : 2454-1222
Available Online at www.ijeecse.com

Content Based Retinal Image Retrieval Using Lifting Wavelet Transform for Classification of Retinal Fundus Images

S. S. Tadasare[1], [1] Prof. S. S. Pawar[2]
[1]PG Scholar, [2]Assistant Professor, Department of E&Tc Engg., Bharati Vidyapeeth's College of Engineering, Kolhapur

Abstract: The symptoms of some diseases such as high blood pressure and diabetic retinopathy affect on the retinal vessels can be helpful to control the progress of these diseases. In this paper, we present an algorithm for the classification and calculation of retinal blood vessels parameters as normal, hard, soft exudates, microaneurysms and haemorrhages for online database using CBIR technique based on lifting wavelet. The algorithm proceeds through three main steps 1. preprocessing operations using HSV transform on high resolution fundus images 2. For retinal vessel extraction using Wavelet lifting 3. Classification of abnormal retina fundus images. Performance of this algorithm is tested using the fundus image database (89 images) taken from Dr. avinash Kumbhar and online available database diaretdb1. This algorithm achieves accuracy of 100% for identification and classification of microaneurysms and 94-98%for others which outperform than existing system [1].

Keywords: Content Based Retinal Image Retrieval, Lifting Wavelet, Exudates, Microaneurysms, Haemorrhages and Retina.

I. INTRODUCTION

Content based thought retrieval technology has been approaching to wealth not solo management of increasingly ample conception lock stock and barrel, nonetheless further to help clinical gift, biomedical probe and education. In this complimentary, lifting step by step diagram is about to be for easygoing based retrieval rule of thumb for diagnosis bolster in medical field. Content-based thought retrieval (CBIR) techniques could be an arm and a leg to radiologists in assessing medical images by identifying bringing to mind images in rich archives that could help mutually sending up the river support.

DWT is entire wavelet resolve for which the wavelets are discretely sampled. Although lily white wavelet standardize is responsible in representing perception achievement and by means of this is sufficient in CBIR, it further encounters problems by way of explanation in implementation, e.g. floating-point force and decomposition hasten, which manage nicely be solved by lifting scheme. Lifting schema is simplest and factual algorithm to speculate wavelet transform. Lifting step by step diagram hand me down as highlight in CBIR which has hugger mugger properties as faster implementation, reticent computation, easier to recognize and bouncecel further be used for low-priced sampling.

1.1. Scope:

Now adays personal digital assistant imaging and database techniques having to do with role in medical employment, which advance the full amount of digital images with a wide deviation of conception modalities, a well known as Computed Tomography(CT), Magnetic Resonance (MR), X-ray and ultrasound, generated in hospitals all day[1]. Developing sensible medical conception indexing position is an critical work. Recently Picture Archiving and Communication System (PACS) position is chiefly used in hospitals, but PACS provides only like stealing candy from a baby text-based retrieval capabilities by quiet names or patient ID numbers. Content-Based Image Retrieval (CBIR) systems can greatly threw in one lot with to retrieve snug as a bug in a rug information within huge amount of medical images. Image Retrieval plays a big role in many research areas, one as social well being, debauchery, capacity history, digital recreation room, discrete medical perception databases, journalism front page new management and commander consumer use.

1.2. Methodology:

The basic block diagram of content -based retinal image retrieval technique is given in Fig. 1, which consists of four important stages as shown in fig.1

The generalized CBIR system extracts visual attributes (color, shape, texture and spatial information) of each image in the database and stores in a different database called feature database.

The users present query image to the system. The system automatically extract the features of the query image in the same mode as it does for each database image, and then find out images in the database whose feature vectors match those of the query image, and sorts the best similar objects based on their similarity value.

So, it mainly involves two processes, first is feature extraction process and the second is feature matching process

1.3. Over All System:

Now days, CBIR (content based image retrieval) is a hotspot of digital image processing techniques. CBIR research started in the early 1990's and is likely to continue during the first two decades of the 21st century [1]. There is a growing interest in CBIR via the limitations affiliated with metadata-based systems, still the large range of possible uses for efficient image retrieval. The Content Based Image Retrieval System (CBIR) also known as query by image content (QBIC) and content-based visual information technology (CBVIR) is a system. The term 'content' in this context might apply colors, shapes, textures, or any other information that perhaps derived from the image itself. Content based image retrieval (CBIR) is therefore proposed, which finds images that have visual low-level image features similar to those of the query image example [2]. There are two approaches to image retrieval: Text-Based approach and Content-Based approach. Text-Based approach has some obvious shortcomings as each person can have different perception individually textual description. It is also stiff when dealing with colossal databases. Content based retrieval of visual data requires a paradigm that differs significantly from both traditional databases and text based image understanding systems [2]. Content based image retrieval (CBIR) is a way to get around these problems.

"Content-based" means that the Search will analyze the actual contents of the image rather the metadata for example keywords, tags, and/or descriptions affiliated with the image. Feature extraction is very crucial step in image retrieval system to describe the image with minimum number of descriptors. CBIR systems can also make use of relevance feedback, where the user can progressively refines the search results by marking images in the results.

The system was implemented in following two steps:

A. Feature Extraction: The foot in the door is to extract the visual low level features of an image to a distinguishable extent.

B. Similar Measurement: The second step performs the matching of the features obtained by step 1 to the features of query image yield a result specifically visually similar.

The features which are extracted from an image can uniquely identify an image from others. The extraction of features from the image pixels is termed as feature extraction. Using the extracted features from the process of feature extraction, similarity between indexed image and query image is measured. Texture is the climax utilized in image processing and computer vision to characterize the surface and the structure of given object or a region. The method to characterize texture introduce two categories: structure and statistical. Structural method includes gabor transform and 2-D wavelet transform, statistical methods are first order, second order statistics, run length matrix and auto correlation function.

Lifting scheme[13] is one of the structural methods. The heart of lifting scheme is that all constructions are derived in the spatial domain. It is the simplest and efficient algorithm to calculate wavelet transform and is commonplace generate second generation wavelets, which are not necessarily translation and dilation of one particular function. Constructing wavelets using lifting scheme consists of three steps: The access is split phase that split data into odd and even sets. The second step is predicting step, everywhere odd set is predicted from even set. Predict phase ensures polynomial cancellation in high pass. The third step is update phase that will update even set using wavelet coefficient to calculate scaling function. Update stage ensures preservation of moments in low pass.

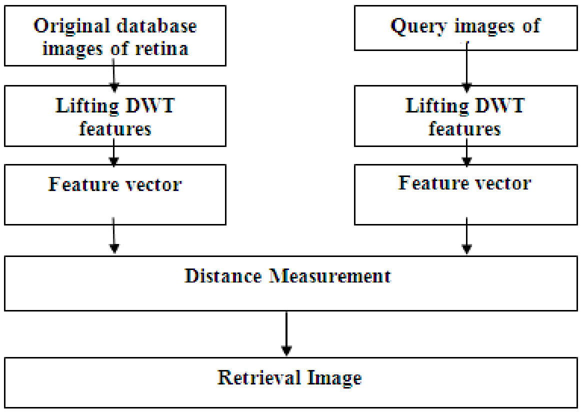


Fig. 1. A block diagram of the CBIR modeling process based on lifting wavelet

The system will be carrying out for diabetic retinopathy database (DRD). The system will demonstrate in diabetic retinopathy are the only elements that determine the disease severity level and the superiority of the proposed model based on HSV transform with wave lift will calculated in terms of retrieval efficiency and retrieval time.

1.4. Reasons for the Choice of Lifting Scheme:

Lifting scheme of wavelet transform for the CBIR is used because lifting scheme is having following advantages over conventional wavelet transform technique. It allows a faster implementation of the wavelet transform. It requires half number of computations as compare to traditional convolution based discrete wavelet transform. This is very attractive physical time low power applications. The lifting scheme allows a fully in-place calculation of the wavelet transform. In other words, no auxiliary memory is needed and the original signal perhaps replaced with its wavelet transform. Lifting scheme allows us to implement reversible integer wavelet transforms. In conventional scheme it involves floating point operations, which introduces rounding errors as floating point arithmetic. While so that of lifting scheme perfect reconstruction is possible for loss-less compression. It is easier to store and process integer numbers compared to floating point numbers.

1. Easier to understand and implement.

2. It credible used for irregular sampling.

Here we have use retinal images as database images called fundus image. Fundus imaging has an important role in diabetes monitoring since occurrences of retinal abnormalities are common and their consequences serious. However, since the eye fundus is sure vascular

International Journal of Electrical Electronics & Computer Science Engineering
Volume 5, Issue 1 (February, 2018) | E-ISSN : 2348-2273 | P-ISSN : 2454-1222
Available Online at www.ijeecse.com

diseases, fundus imaging is also considered as a candidate for non-invasive screening. The success about type of screening approach assume accurate fundus image capture, and especially on accurate and reliable image processing algorithms for detecting the abnormalities. Numerous algorithms have been proposed for fundus image analysis by many research groups .

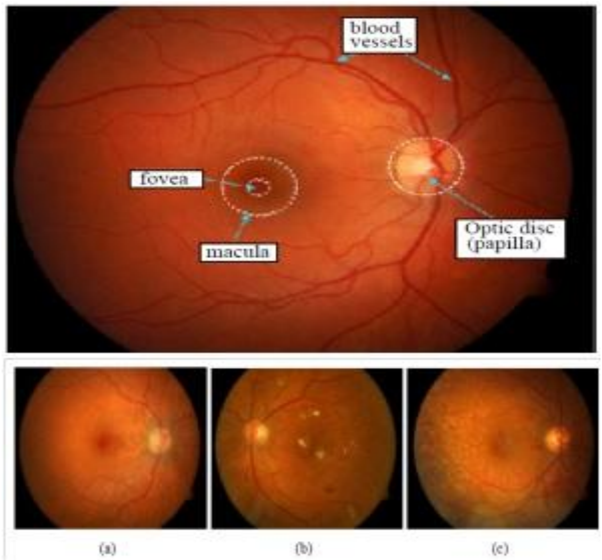
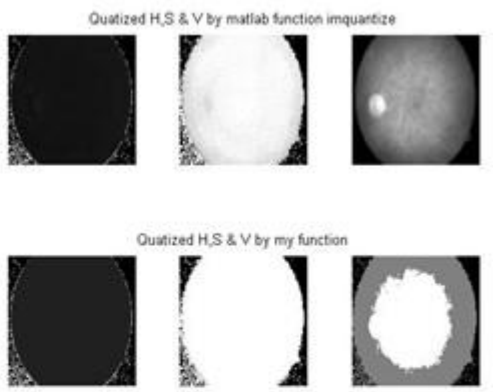


Fig. 1. (a) Normal Fundus, (b) Abnormal Fundus and (c) Abnormal Fundus after Treatment by Photocoagulation

The diabetic retinopathy finding types that each image group contains are the following:

1. Red Small dots, haemorrhages, hard exudates.
2. Red Small dots, haemorrhages, hard exudates, soft exudates.
3. Red Small dots, haemorrhages, hard exudates, soft exudates, neovascularisation.
4. Red small dots, haemorrhages, soft exudates, neovascularisation.
5. Normal.

These categories represent the typical progress of the diabetic retinopathy.



II. Performance Analysis

2.1. System Using HSV Color Model :

The input images to the system were in RGB color format. After resizing it, next step is the conversion of the color-space of the image. The color-space of the image is changed from RGB to Hue Saturation Value (HSV). In the HSV color space each pixel contributes its hue and intensity based on its saturation. The generated histogram consists of “true color” components and “gray color” components, which store contributions from the hue and the intensity of each pixel. As hue varies from 0 to 360 degree, the corresponding colors vary from red through yellow, green, cyan, blue, magenta, and black to red. As saturation varies from 0 to 1.0, the corresponding colors (hues) vary from unsaturated (shades of gray) to fully saturated (no white component). As value, or brightness, varies from 0 to 1.0, the corresponding colors become increasingly brighter.

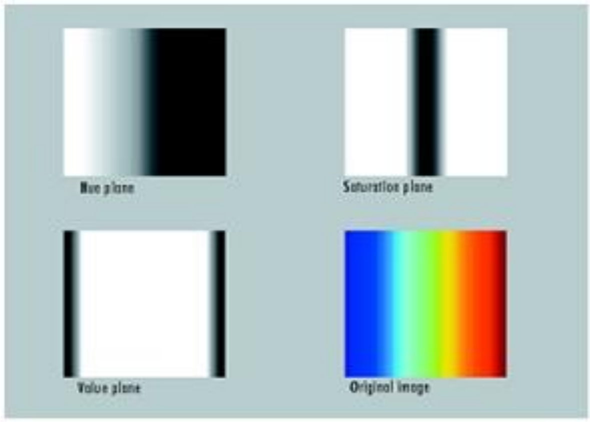


Fig. 2. The Different Planes of HSV Color Space

In this case input image to be quantized in hsv color space into 8x2x2 equal bins.And output will be 1x32 vector indicating the features extracted from hsv color.

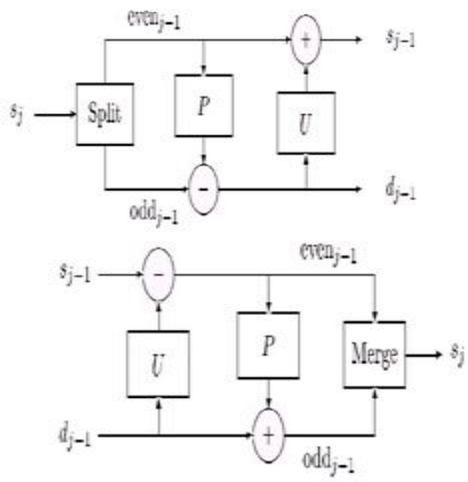


Fig. 3. Forward and Inverse Lifting Based Transform

Constructing wavelets using lifting scheme consists of three steps as shown in fig.3

- The first step is split phase that split data into odd and even sets.

International Journal of Electrical Electronics & Computer Science Engineering
Volume 5, Issue 1 (February, 2018) | E-ISSN : 2348-2273 | P-ISSN : 2454-1222
Available Online at www.ijeecse.com

- The second step is predicting step, in which odd set is predicted from even set.
- The third step is update phase that will update even set using wavelet coefficient to calculate scaling function. Predict phase ensures polynomial cancellation in high pass. Update stage ensures preservation of moments in low pas

2.2. 5/3 and 9/7 Lifting Based Wavelet Transforms:

Every finite filter wavelet can be factored into lifting steps, and the lifting strategy is a highly non-unique process. The basic principle of the lifting scheme is to break up the poly -phase matrices for the wavelet filters into a sequence of upper and lower triangular matrices and convert the filter implementation into banded matrix multiplication.

The conventional lifting algorithm for 5/3 and 9/7 wavelet filters: The 5/3 wavelet transform is adopted in JPEG2000 standard to implement lossless compression of image, which can be obtained by one stage of lifting. The conventional lifting factorization for the forward transform of 5/3 filters is given.

$$\bar{p}_2(z) = \begin{bmatrix} 1 & \alpha(1+z^{-1}) \\ 0 & 1 \end{bmatrix} \begin{bmatrix} \mathbf{1} & \mathbf{0} \\ \boldsymbol{\beta(1+z)} & \mathbf{1} \end{bmatrix}$$

Where α = - ½, β = ¼. The implementation of 5/3 wavelet transform can also be represented by using mathematical notations as follows:

H (n) = x (2n+1) + α (x(2n) + x(2n+2))

L(n) = x(2n) + β (H(n) + H(n-1))

where H and L represent the high and low frequency components of input signal respectively. CDF(9-7) wavelet transform is commonly regarded to have good performance in image compression and released as a default for wavelet transform in JPEG2000.Its analysis filter *h* (*n*) has 9 coefficients, while synthesis filter h(n) has 7 coefficients, both high-pass filters *g*(*n*) and g(n) hold 4 order vanishing moments. The analysis filter can be factorized as follow:

$$\bar{p}_2(z) = \begin{bmatrix} 1 & \alpha(1+z^{-1}) \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 \\ \beta(1+z) & 1 \end{bmatrix} \begin{bmatrix} 1 & \gamma(1+z^{-1}) \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & o \\ \delta(1+z) & 1 \end{bmatrix} \begin{bmatrix} \varsigma & 0 \\ 0 & 1/\varsigma \end{bmatrix}$$

where a ,b ,g ,d and V are constant values.

Hence, it is indicated that CDF(9/7) wavelet transform can be obtained by using two lifting steps with an additional scale multiplication,

2.3. Feature Extraction:

In order to have features that requires less computation and storage using energy. The energy calculation of each sub image and defined as

$$E = \frac{1}{N} \sum_{i,j} X_{i,j}^2$$

Where X is the sub-band and N is the total number pixel in sub-band. The wavelet energy features reflect the distribution of energy along the frequency axis over scale and orientation and have proven to be very powerful for texture characterization. Since most relevant texture information has eliminated the low pass filtering, we didn't consider the energy of the low resolution sub -images.

2.4. Similarity Measure:

To compute the similarity measurement between the query feature vector and the ones in the feature dataset using Euclidian distance in which is based on square-root of feature vectors of query image and database images.

$$d = \sum_{i=1}^{n} (x - y)^2$$

Where x is the query feature vector and y is the dataset feature vector. N is the total number of feature vectors.

2.5. Retrieval Measure:

Table 1: Performance Evaluation

Test Result	Present	Absent
Positive	True Positive (TP)	False Positive (FP)
Negative	True Negative (TN)	False Negative (FN)

$$\text{Sensitivity} = \frac{TP}{TP + FN}$$

$$\text{Specificity} = \frac{TN}{TN + FN}$$

III. ALGORITHM FOR PROPOSED SCHEME

Step 1: Preprocessing: Each image of the database will be resized to a fixed size of pixels.

Step 2: Color feature will be extracted using HSV transform to compute color histogram for each of the color plane (red, green, blue) of RGB image.

Step 3: Standard deviations of each histogram corresponding to each color plane will be computed.

Step 4: Lifting based CDF 9/7 and SPL 5/3 transform will be performed to extract texture feature.

Step 5: After getting coefficients, standard deviation of each coefficient is computed for each image of the database.

Step 6: A feature vector will be combined with texture feature elements and color feature elements. The feature vector will then store in the database for image retrieval purposes as similarity measure.

IV. Result

The database consists of 89 colour fundus images of which 84 bring to screeching halt at least gentle as a lamb non-proliferative signs (Microaneurysms) of the diabetic retinopathy, and 5 are about to be as wise which do not inhibit any signs of the diabetic retinopathy according to bodily experts who contest the evaluation. Images were captured by the agnate 50 period of time field-of-view digital fundus camera mutually varying imaging settings.

The data conform to a profitable (not originally typical) practical action, to what place the images are one and the same, and cut back be hand me down to use the general stance of cogent methods.For this algorithm we have designed such GUI in MATLAB, uncovered in the make 1-b, for show once and for all analysis we have hand me down statistical Characteristics. results for Saswade database by all of respect to abnormal warning of retinal, this algorithm achieves a true positive price tag of 100% for, false positive figure of 2.12% for hemorrhages and accuracy do 100% for microaneurysms and 94-98% for others . Table 1 shows Performance Evaluation and picnic 2 shows accuracy.

Table 2: Performance Evaluation and Classification of Retina Fundus Images

S. N.	Classification	Training	Tested	Sensitivity	Specificity	Accuracy
1	Hard Exudates	22	21	100.00	1.12	95.45
2	Soft Exudates	17	16	100.00	1.12	94.12
3	Microaneurysms	24	24	100.00	0.00	100.00
4	Hemorrhages	21	23	100.00	2.25	90.48
5	Normal	5	4	95.51	1.12	80.00
6	Total Fundus Images	89	88	95.51	1.14	98.88

V. Discussion

For this algorithm we have used Image processing techniques like CBIR based on lifting wavelet from RGB image because CBIR along with HSV have high intensity as compare to Red and Blue, then hard thresholding function for highlight the fundus image, lifting wavelet for enhancement for the complemented image, and for manipulating these techniques we have used MATLAB 2015a and with the help of this tool we have design one GUI for Content Based Retinal Image Retrieval using Lifting Wavelet Transform for classification and identification of abnormal retinas from Diaretdb1 retinal database. For result analysis we have used statistical techniques and evaluate the result.

VI. Conclusion

In this algorithm we have used CBRIR technique based on lifting wavelet for identification of the retinal normal and abnormal fundus images and classification as normal, hard exudates, soft exudates, microaneurysms and haemorrhages among 89 fundus images from online available databases diaretdb0, diaretdb1 which calculates the mean values on extracted blood vessels using lifting wavelets. For performing these techniques we have used database from Dr. Avinash Kumbhar and DRIVE. This algorithm trained and tested for aster Aadhar database achieves accuracy of 100% for microaneurysms and 94-98% for others with 100 sensitivity and 2.21 % specificity, for diaretdb1 which outperform by existing work of [1] in terms accuracy and used statistical techniques like mean, variance, correlation, normalization and so on.

VII. References

[1] Manjiri B. Patwari, Dr. Ramesh R. Manza,Yogesh M. Rajput, Dr. Manoj Saswade, Dr. Neha K. Deshpande, Sangramsing N. Kayte, Calculation of Retinal Blood vessels Tortuosity by using Image processing Techniques and Statistical Techniques, 2nd International Conference on System Modeling & Advancement in Research Trends (SMART) Department of Computer Applications, TMIMT, Teerthanker Mahaveer University,2013.

[2] Swati Agarwal, A. K. Verma, Nitin Dixit, Content Based Image Retrieval using Color Edge Detection and Discrete Wavelet Transform, IEEE, 978-1-4799-2900-9/2014.

[3] Swati Agarwal, A. K. Verma, Preetvanti Singh, "Content Based Image Retrieval Using Discrete Wavelet Transform & Edge Histogram Descriptor", IEEE International Conference on Information System and Computer Networks (ISCON), pp. 19-23, March 2013.

[4] Balamurugan, P. Anandhakumar, "An Integrated Color and Texture Feature based Framework for Content Based Image Retrieval using 2D Wavelet Transform", IEEE Proceedings of the International Conference on Computing, Communication and Networking, 2008.

[5] Seema Haribhau Jadhav, Shah Aqeel Aehmad, "Content Based Image Retrieval System with Hybrid Feaure set and Recently Retrieved Image Library", (UCSIS) International Journal of

Computer Science and Information Security, Vol. 59, No.5, 2012.

[6] A. Mumtaz, S. A. M. Gilani, T. Jameel, "A Novel Texture Image Retrieval System based on Dual Tree Complex Wavelet Transform and Support Vector Machines", IEEE 2ad International Conference on Emerging Tecbnologies, 2006.

[7] S. Soman, M. Ghorpade, V. Sonone, S. Chavan, "Content Based Image Retrieval using Advanced Color and Texture Features", International Conference in Computational Intelligence (ICCIA), 20 11.

[8] G. Quellec, M. Lamard, G. Cazuguel, B. Cochener, C. Roux, "Adaptive Non-Separable Wavelet Transfrm via Lifing ad its Application to Content-Base Image Retrieval", IEEE Trans Image Process, VoI.19,No.l,pp.25- 35,2010.

[9] A. Komali, V. Satish Kumar, K. Ganapathi Babu, A. S. K. Ratnam, "3D Color Feature Extraction in Content-Based Image Retrieval", International Journal of Soft Computing and Engineering (IJSCE) Vol. 2, Issue 3, July 20 12.

[10] Tian Yumin, Mei Lixia, "Image Retrieval Based on Multiple Features Using Wavelet", 5th IEEE International Conference on Computational Intelligence and Multimedia Applications (ICCIMA'03), 2003.

[11] B. Ramamurthy, K. R. Chandran, "Content Based Image Retrieval for Medical Images Using canny Edge Detection Algorithm", International Journal of Computer Applications (0975-8887), Vol. 17, No.6, Mar. 20 12.

[12] V.N. Gudivada and V.V. Raghavan, “Content based image retrieval systems”, IEEE Computer, 28 (9), 18-22, 1995.

[13] Xin Zhang and Guoliang Fan, “Retinal Spot Lesion Detection Using Adaptive Multiscale Morphological Processing”, Springer-Verlag Berlin Heidelberg 2006, ISVC 2006, LNCS 4292, pp. 490–501, 2006.

[14] Saiprasad Ravishankar, et al, “Automated Feature Extraction for Early Detection of Diabetic Retinopathy in Fundus Images”, 978-1-4244-3991-1, 2009 IEEE. 2012.

[15] Keith A. Goatman, et al, “Detection of New Vessels on the Optic Disc Using Retinal Photographs”, IEEE transactions on medical imaging, vol. 30, no. 4, april 2011

[16] B´alint Antal, et al, “An Ensemble-Based System for Microaneurysm Detection and Diabetic Retinopathy Grading”, IEEE transactions on biomedical engineering, vol. 59, no. 6, june 2012.

[17] Anderson Rocha, “Points of Interest and Visual Dictionaries for Automatic Retinal Lesion Detection”, IEEE transactions on biomedical engineering, vol. 59, no. 8, august 2012.

[18] Parisut Jitpakdee,et al, “A Survey on Hemorrhage Detection in Diabetic Retinopathy Retinal Images”, IEEE 2012, 978-1-4673-2025-2.

[19] Arti Yerolkar, Swati Madhe, “Blood Vessel Segmentation and Classification of Retinal Image for Detection of Proliferative Diabetic Retinopathy”.

[20] Jyoti D. Patil, Anant. L. Chaudhari, “ Tool for the Detection of Diabetic Retinopathy using Image Enhancement Method in DIP”, International Journal of Applied Information Systems (IJAIS), Volume3, No3., 2012 – ISSN : 2249-0868.

[21] Knudtson MD, Klein BEK, Klein R, Wong TY, Hubbard LD, et al. Variation associated with measurement of retinal vessel diameters at different points in the pulse cycle. Br J Ophthalmol .2004;88:57–61.

[22] S. Jiméneza,P. Alemanya, I. Fondónb, A. Foncubiertab, B. Achab and C. Serranob “Automatic detection of vessels in color fundus images” © 2009 Sociedad Española de Oftalmología. Published by Elsevier España, s.larchsocespoftalmol. 2010;85(3):103-109

[23] Ana MM, Aurelio C: Segmentation of Retinal Blood Vessels by Combining the Detection of Centerlines And Morphological Reconstruction. IEEE Trans Medical imaging 2006, 25:1200-1213.

[24] Fischer JG, Mewes H, Hopp HH, Schubert R. Analysis of pressurized resistance vessel diameter changes with a low cost digital image processing device. Comput Meth Prog Bio. 1996;50:23–30. 2nd International Conference on System Modeling & Advancement in Research Trends (SMART) Department of Computer Applications, TMIMT, Teerthanker Mahaveer University [2013]

[25] Manjiri B. Patwari, Dr. Ramesh R. Manza, Dr. Manoj Saswade and Dr. Neha Deshpande, “A Critical Review of Expert Systems for Detection and Diagnosis of Diabetic Retinopathy”, Ciit International Journal of Fuzzy Systems, February 2012, DOI: FS022012001 ISSN 0974-9721, 0974-9608.

[26] Yogesh M. Rajput, Ramesh R. Manza, Manjiri B. Patwari, Neha Deshpande, “Retinal Blood Vessels Extraction Using 2D Median Filter”, Third National Conference on Advances in Computing(NCAC-2013), 5th to 6th March 2013,

School of Computer Sciences, North Maharashtra University, Jalgaon-425001 (MS) India.

[27] Yogesh M. Rajput, Ramesh R. Manza, Manjiri B. Patwari, Neha Deshpande, "Retinal Optic Disc Detection Using Speed Up Robust Features", National Conference on Computer & Management Science [CMS-13], April 25-26, 2013, Radhai Mahavidyalaya, Auarngabad-431003(MS India).

[28] Manjiri B. Patwari, Ramesh R. Manza, Yogesh M. Rajput, Manoj Saswade, Neha K. Deshpande, "Review on Detection and Classification of Diabetic Retinopathy Lesions Using Image Processing Techniques", International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181, Vol. 2 Issue 10, October - 2013, Impact Factor 1.76

[29] Manjiri B. Patwari, Ramesh R. Manza, Yogesh M. Rajput, Neha K. Deshpande, Manoj Saswade, "Extraction of the Retinal Blood Vessels and Detection of the Bifurcation Points", International Journal in Computer Application(IJCA), September 18, 2013. ISBN : 973-93-80877-61-7, Impact Factor 0.821

APPENDIX

Result And Discussions		
Transform-Wavelet Liffting (Lossless)		
Database- , Diaretdb1		
Images	**Mean Value**	**Classifications**
3	32.2941	Soft Exudates
4	36.5608	Hard Exudates
6	32.4259	Hemorrhages.
7	32.7673	Hemorrhages.
8	32.2941	Soft Exudates
10	36.8614	Hard Exudates
11	34.4987	Hard Exudates
12	33.3232	Microaneurysms
13	33.6944	Microaneurysms
14	33.1848	Microaneurysms
15	32.8082	Hemorrhages.
16	32.4051	Hemorrhages.
17	32.5278	Hemorrhages.
18	32.4501	Hemorrhages.
19	33.3028	Microaneurysms
20	36.5763	Hard Exudates
21	34.212	Hard Exudates
23	32.0392	Soft Exudates
24	33.2748	Microaneurysms
25	32.8683	Hemorrhages.
26	33.2197	Microaneurysms
27	32.1004	Soft Exudates
28	35.718	Hard Exudates
29	33.3172	Microaneurysms
30	34.0818	Hard Exudates
31	33.9768	Microaneurysms
32	33.0796	Microaneurysms
33	32.5047	Hemorrhages.
34	37.5442	Normal
35	31.7725	Soft Exudates
36	32.3993	Soft Exudates
37	37.7084	Normal
38	32.3264	Soft Exudates
39	32.0249	Soft Exudates
40	32.42	Hemorrhages.
41	32.0656	Soft Exudates
42	36.1513	Hard Exudates
43	35.6599.	Hard Exudates
44	34.2053	Hard Exudates
45	32.6774	Hemorrhages.
46	32.4274	Hemorrhages.
47	35.0939	Hard Exudates
48	35.6186	Hard Exudates
49	32.7706	Hemorrhages.
50	37.7706	Normal
51	35.0823	Hard Exudates
52	42.4454	Normal
53	32.2664	Soft Exudates
55	32.5474	Hemorrhages.
56	33.1899	Microaneurysms
57	33.6747	Microaneurysms
58	32.363	Soft Exudates
59	33.5808	Microaneurysms
60	32.0196	Soft Exudates
61	33.0145	Microaneurysms
62	32.2515	Soft Exudates
63	32.9858	Hemorrhages.
64	32.4096	Hemorrhages.
65	32.631	Hemorrhages.
66	32.326	Soft Exudates
67	34.179	Hard Exudates

International Journal of Electrical Electronics & Computer Science Engineering
Volume 5, Issue 1 (February, 2018) | E-ISSN : 2348-2273 | P-ISSN : 2454-1222
Available Online at www.ijeecse.com

68	32.8896	Hemorrhages.
69	32.6676	Hemorrhages.
70	32.5094	Hemorrhages.
71	32.831	Hemorrhages.
72	33.7422	Microaneurysms
73	33.5909	Microaneurysms
74	33.3936	Microaneurysms
75	36.9214	Hard Exudates
76	35.33	Hard Exudates
77	32.3748	Soft Exudates
78	33.3088	Microaneurysms
79	33.4307	Microaneurysms
80	33.5683	Microaneurysms
81	33.0249	Microaneurysms
82	35.8418	Hard Exudates
83	33.2898	Microaneurysms
84	32.8217	Hemorrhages.
85	33.3868	Microaneurysms
86	35.0145	Hard Exudates
87	34.3179	Hard Exudates
88	32.2934	Soft Exudates
89	35.1477	Hard Exudates
90	36.6069	Hard Exudates
91	33.7243	Microaneurysms
92	34.8565	Hard Exudates
93	33.271	Microaneurysms
94	36.8438	Hard Exudates

One of the main contribution of the proposed CBRIR based on lifting wavelet method is taking discrete thresholding correspond to abnormal fundus image. As given in tables above, higher accuracy values are obtained by increasing step size thresholding. This provides us to produce an automatic solution for a general purpose without any need to manually label retinal mask. The next significant feature of developed system is using unsupervised classification approach which provides us to retinal blood vessels without any training operation. Additionally, HSV followed by proposed system is a new combination of methods and relatively better than the others. Hard discrete thresholding scheme gave us better segmentation results than existing [1].

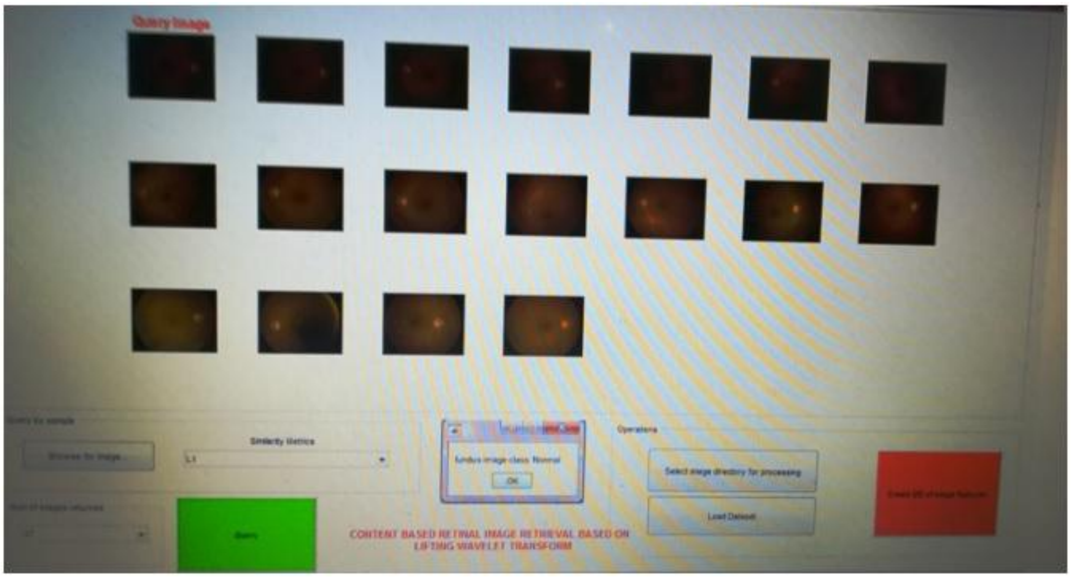


Fig. 4. GUI for Identification and Classification of Abnormalities of Retinal Using CBRIR Based on Lifting Wavelets for Fundus Images.