IOSR Journal of Engineering (IOSR JEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
PP 61-69

Review Paper on Detection of Diseases of Eyes Using Soft Computing Technique

AkshadaBhingardive[1,] BansodeBalbhim Narhari[2]
Avcoe, Sangamner
Assistant professor AVCOE, Sangamner

Abstract: *Human retina is one of the wellspring of biometric system which gives the most dependable and effective method for confirmation. SVM classifier and has been combined with the feature extraction method to enhance the efficiency of medical image retrieval system.The two cost effective algorithms are planned for exudates recognition and optic disc removal aimed for retinal images arrangement and diagnosis support.Cost effective algorithm is used for optic disc identification.Fundus images are classified into those that are strong and those affected by diabetes, based on the detection of optic disc and exudates.Artificial Neural Networks (ANN) givesreliable diagnosis and takes less time than the reading center model.To convert objectively measurable parameters to "category memberships fuzzy logic is used.Artificial Neural Network (ANN) and Support Vector machine are used to separate the various images based on features.*
Machine (SVM) .Optical Coherence Tomography (OCT) is used to detect present of cysts.The transmission for recognition of such deviations in the retina is called Diabetic Retinopathy (DR). By using various features extraction methods and classifiers we can detect the diseases and increase the identification rate.

Keywords: *Diabetic macular edma(DME) Cup Disc ratio (CDR), micro aneurysm, blood vessels, exudates, retinal image, diabetic retinopathy, Support Vector Machine Classifier*

I. Introduction

Swelling in the macular region of retina which is also known as macular edema, is a difficulty of the eye often foremost to reduced capacity of vision. Diabetic macular edema (DME) caused due to diabetes is a high risk obstacle which can cause irreversible loss of vision [1]–[3]. Early detection of even a minor sign of DME is critical as it may also appear without any external indications [4]. According to current status Diabetes is the third leading cause of expiry after cancer and heart diseases. The serious obstacles of uncontrolled diabetes include kidney damage, eye damage, nerve disease and stroke. Diabetic retinopathy (DR) is a common retinal problem related with diabetes. The Diabetic Retinopathy finds the exudates parts in the eye by applying Neuro Fuzzy based on feature extraction. Diabetic retinopathy is an eye disease that is noticed in patients with extensive time diabetes. Diabetic retinopathy indications the swelling of the retina leaks or irregular growth of blood vessels, resulting in severe vision loss or blindness. The presence of micro aneurysms (MAs) is usually an early sign of diabetic retinopathy and their spontaneous detection from shade retinal images is of clinical attention. DIABETIC retinopathy (DR) is a major community health matter since it can lead to impaired vision in patients with diabetes.Microaneurysms (MAs) is usually the first clinical indication of DR. They are swellings of capillaries caused by a failing of the vessel wall [2]. Their sizes range from 10 to 125 μm [5].Diabetic Retinopathy is a dangerous eye disease and the most common cause of vision loss for worldwide people. Digital shade fundus images are suitable for diagnosing Diabetic Retinopathy.Diabetes mellitus (DM) has been identified as one of the noticeable causes of death, disability, and blindness in the world. According to World Health Organization (WHO) statistics, more than 285 mil-lion people around the world have DM and it is predicted to reach439 million people by 2030 [6]. Diabetic retinopathy (DR) is the greatest common eye disease that affects patients with DM.

II. Significance of Anatomical Structure Detection

The optic disc is a circular to oval white area computing about 2 x 1.5 mm across in dimensions. The major blood containers of the retina are exuded from the center of the optic disc. Another important structure is the slightly oval-shaped, blood container-free reddish spot, the fovea, which is at the center of the area known as the macula by ophthalmologists. The total retina is a circular disc of between 30 and 4 mm in diameter. The statistics of blood containers, such as length, width, tortuosity and separating pattern, can not only provide information on pathological changes but can also help to grade diseases strictness or automatically diagnose the diseases. Optic disc parameters such as span can allow detection of other retina structures such as the fovea region.

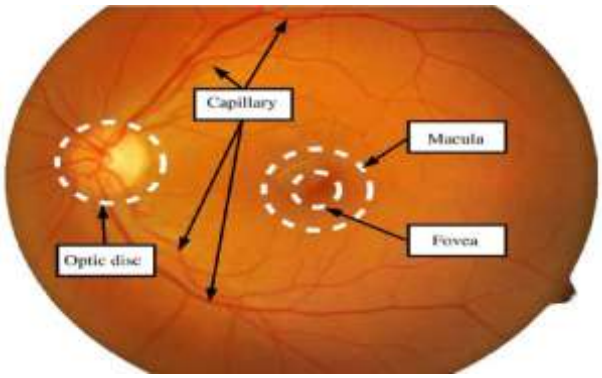

Fig.1. Sample retinal image with anatomical structures

III. Literature review

Many important eye diseases as well as systematic diseases visible themselves in the retina. The main reason of blindness in people with diabetes is Diabetic Macula Edema (DME) which is common in type 2 diabetes. Diabetic Retinopathy is a obstacle caused by diabetes mellitus and the second most joint cause of blindness and visual loss in the US. The exudates in the DR are caused by buildup of proteins and lipids from blood leaking into the retina complete damage blood vessels. They seem as bright, reflective, heavy white/cream highlighted areas on the ophthalmoscope. There are number of approaches reported on the subject area to identify the hard exudates. An automated analysis of fundus image is very essential and will aid to assist clinical identification. The various diseases that will affect eye are found out with the help digital fundus image. The primary principle for the detection of intraregional fatty (hard) exudates, that are not objective a principle sign of DR, but likewise an warning of the natural event of co-existent retinal edema and if present in the fissionable area, exudates are major players of vision loss in diabetic retinopathy.[24]

1. Cup Disc Ratio:

Then optic cup and disk are removed as shown in figure 2. Once the optic cup and optic disc are removed, and then comes the measurements of the Cup Disc ratio (CDR). It is calculated as shown in Fig 2. Typical optical cup region and optical disk region is shown in fig 3..Once the cup and disc boundaries are found, we will follow clinical method of detecting Cup-Disc Ratio which is an indicator for the exposure of the presence of glaucoma disease in the patient.

CDR = Area of the Cup / Area of the Disc

When the cup-disc ratio rises over a threshold value, we consider that the patient is distress from glaucoma or we can say that the patient is glaucomatous.

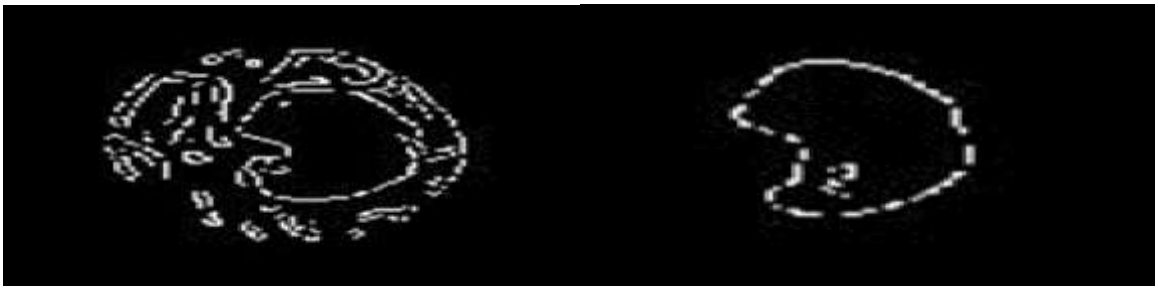

Fig.2 Measurement of Cup to disc ratio **Fig.3.**Extraction of optic disk and optic cup

2.Surf Descriptor And Pattern Recognition Techniques In Automatic Identification Of Pathological Retinas (2015) Rodrigo Veras, Romuere Silva , Fla´vioArau´jo, Fa´tima Medeiros [26] applied the Speed Up Robust Feature ,developed algorithm that finds points of notice to form visual wordlists. To assemble these interest points k-means clustering algorithm is used. To determine whether an image is healthy or consists any type of symptoms of disease this paper uses multiple classifiers.

Advantages

1. Able to detect characteristic points of each image .
2. The method proposed is robust.
3. The accuracy rate was 97.25

Disadvantages
1. Poor performance as the algorithm is not able to detect small artifacts.
2. There is loss of information during the creation of the visual dictionary.

3.Feature extraction from the fundus images for the diagnosis of Diabetic Retinopathy (2016):To assist early stage of a Diabetic Retinopathy detection of injuries in a fundus image is necessary. This paper uses MAHM algorithm. ManojKumar S B, Manjunath R, Dr. H S Sheshadri [27] proposes new parameter for optic disk detection which detects the major containers and future use the connection of these to find the estimate the region for optic disk. In the further step this region is localized by applying shade properties. This system uses color fundus images as input.

Advantages
1. Provides an efficient framework for Diabetic Retinopathy.
2. Various features such as hemorrhages, micro aneurysms, hard exudates and soft exudates can be detected.

Disadvantages
1. Can only detect Diabetic Retinopathy.

4.Features extraction methods

Various techniques have been adopted for eye detection which includes wavelets, principal component analysis, fuzzy logic, evolutionary calculation and hidden markov models and template matching. Huang and Wechsler [29], used optimal wavelet packets for eye symbol and radial basis functions for sorting of eye and non-eye regions. Talmi, *et al.,* and Pentland, *et al.,* [30, 28] made use of very few appearances of human eyes in Principal Component Analysis for eye detection. Torii, A. and Imiya A [31], used Karhunen-Loeve-Transformation to represent the major features of human eyes and are stored as location patterns for the localization of human eyes in video images.

Devisaranya et al., (2015) proposed a system which is used for identifying Micro aneurysms, which can be known by automatically analyzing the retinal image. Initially the blood containers are removed from the fundus image and classification of blood containers such as blood vessel and veins should be made for determining the container parameters. The Graph trace algorithm is used for the sorting of retinal blood vessels. It also computes parameters of the vessels such as length, caliber measurement and diameters of the container. Diseases can be identified by comparing these parameters with the normal value. If there is any deviance it will indicate the presence of certain diseases. This automatic retinal image analysis decreases the effort and burden of ophthalmologist by providing ophthalmologists.

5.In eye tumour detection system (ETDS): Image processing techniques have been applied in order to increase the eye tumour images. Initially, the original image has been transformed to gray scale in order to reduce the CPU time, followed by image filtering in order to eliminate excess data within the image. Afterwards, image enhancement technique is applied to prepare handled image for image subtraction. Canny edge finding has been applied in segmentation step for image fusion.

6. Image Filtering

Pressing, which is also known as blurring, is an image processing technique that decreases the noise in an image to create significant image for future step. Most pressing techniques are based on low pass linear filters. In order to perform a pressing operation, a filter is applied to an image. The most common type of filters is the linear filters. Median filter is a type of linear filters [32].

Median filter is used to decrease impulsive noise in an image with maintaining the useful features and image edges. Median filtering is a linear process in which the output of the being handled pixel is found by calculating the median of a window of pixels that surrounds the studied pixel[33].

7.**Iris Tumor Detection System (ITDS)**

The system is implemented using Matlab programing language (Matlab 2013 software tools). ITDS is based on different image processing techniques used in order to inspire the human visual examination for sensing the iris tumor into an eye. The eye images (fig. 4 & 5) are obtained from "Miles research" [34]; a public database available on the internet. The images are converted first to gray scale images, and then these images are filtered using median filter in order to enhance their quality. The background image is removed in order to be then deducted from the original one. Image adjustment is applied to the resulted image, thus raises its pixels intensity which clears that the area is then segmented in the next step, the edge finding using canny operator.

The last method is to cover the extracted ROI on the original gray scale image using image mixture in order to mark the tumor region onto the original image

Fig.4. Normal eye

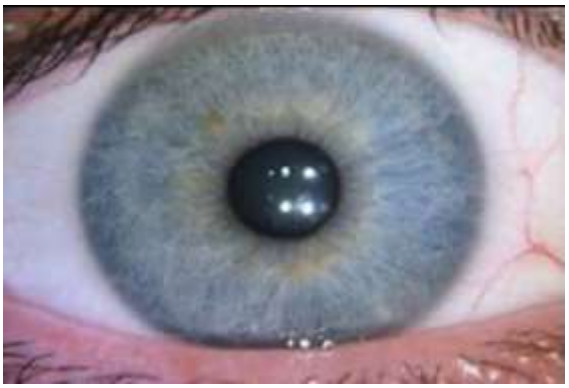

Fig.5. Eye with an iris tumor

8.Grayscale conversion

The first step is to translate the RGB image to gray scale. This translation is done using the luminosity method which relies on the influence of each color of the three RGB colors. Using this method, the gray scale image is brighter since the colors are weighted according to their contribution in the RGB image not averagely [35]

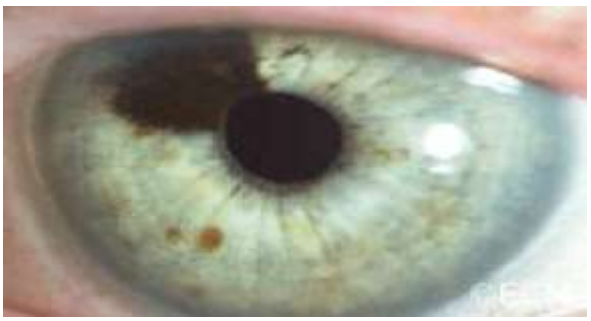

Fig.a

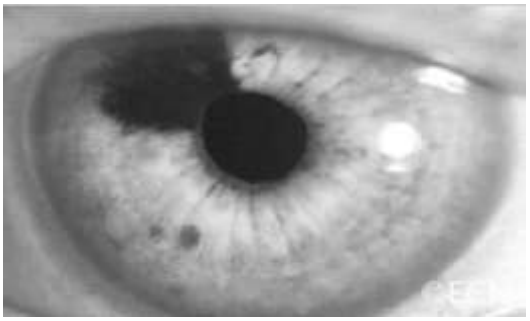

Fig.b

Fig.6.RGB image of an eye with iris tumor, (b) Gray scale converted image of (a).

9. Image Addition

This technique results in a brighter image. Image addition is used to design system to clear and enhance the tumour area by buildup more pixels to image in the designed system. This technique is to add the removed background image to the original image which results in a brighter and enhanced image.

10.Image Adjustment

Image adjustment is growing the image intensity and its quality. This image handling technique intends to increase the quality and brilliance of the image by growing the intensity of its pixels. This is done by changing the difference or brightness of an image. In this procedure, pixel values below a definite value are displayed as black and pixel values beyond a specified value are shown as white, and pixel values in between these two values are showed as shades of grey. The result is a linear mapping of a subset of pixel values to the complete range of greys, from black to white, creating an image of higher contrast [36]

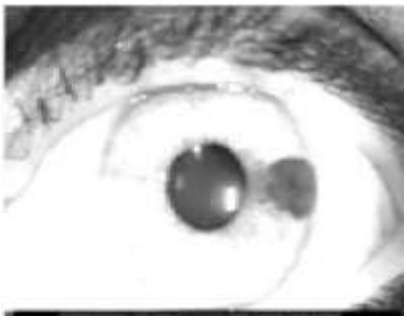

Fig.7. a. addition

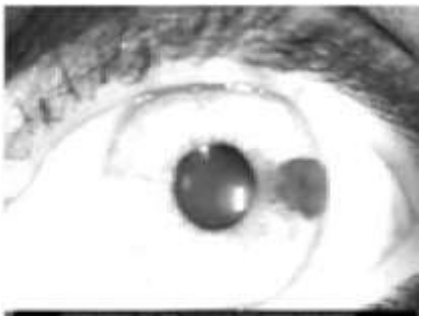

Fig.7.b.Image adjustment

Features extraction methods

i)Candidate Region Extraction (Feature Extraction): Candidate region (lesion) is a small round object which is look like dark red dot and patches in retinal image. We can see them with our naked eye it can be able to classify but they varies based on its texture, divergence and blood containers in the image makes difficult to find its clearly. The phases are extracted by Gabor filter and blood containers are segmented to extract it without any trouble [7]. The Gabor filters are one of the robust and accurate way to identify vessel pattern and its withdrawal make the entire procedure is easier. The dissimilarity enhanced image is given for Gabor filter banks for improvement of lesions. Gabor filters are Well-known due to their fine frequency alteration and orientations electiveness. They are appropriate for texture representation and discrimination [8]. Gabor filter is characterized by a Gaussian kernel function which can model a wide range of shapes depending upon the values of its parameters [7].

2. Pre-Processing Medical images may suffer from poor dissimilarity and noise during image achievement with respect to scanning devices and illumination etc. Dissimilarity enhancement can be attained by using histogram equalization technique. A 3x3 Median filter will be adapted for noise elimination from the medical images.

3. Image processing

Image processing techniques change the gray values of the pixels. There are three fundamental systems by which this is ended. In its most basic way, the pixel gray values are reformed with no processing of around or "neighborhood" pixel values. Neighborhood processing consolidates the estimations of pixels in a small neighborhood about every pixel being referred to. At last, changes are more complex and include control of the whole image so that the pixels qualities are understood in an alternate yet proportional form. This may take into account more creative and capable processing before the picture is frequent to its unique method of representation.[18]

4.Image enhancement

A effort in the captured image of the ocular fundus is picture quality which is unfair by many factors, for example, media opacities, defocus or vicinity of relic [11,12]. Picture enhancement includes the enlargement or improvement of images so that the result is more appropriate for further operations. Image development means the image is more satisfactory for analysis, treating or viewing. This may include procedures, for example, improving complexity or brighten up an image. The picture histogram gives important data about the presence of an image. It comprises of a graph signifying the quantity of times every gray level happens in the image. Horizontal line of the graph shows the possible gray level existing in the images, e.g., 0–255. The vertical line of the graph specifies number of occurrence of those gray level pixels. In an unreasonably dull or brightest image, the gray level would be bunched to the limits of the histogram,[19][20]

5. Edge detection

Edge Detection is one of the most commonly used image handling techniques for detecting edges in a very robust manner. Canny edge detection is a procedure to identify and locate sharp in images. To work exactly it has to follow the algorithm steps which are very important to find out limits and should not miss the edge from the images. Secondly, edge points will be limited well means distance between actual edge and edge pixels as found by the detector should be minimum. Thirdly single edge should have only one response. While implementing we can get multiple response to an edge. Based on these criteria, the canny edge detector first smoothes the image to eliminate and noise. It then finds the image grade to highlight regions with high spatial results [9][10].

6. DCT (Discrete Cosine Transform)

The DCT Transform a signal from spatial illustration into a frequency representation. Lower frequencies are more practical in an image than higher frequencies so if we convert an image into its frequency components and throw away a lot of higher frequency measurements, we decrease the amount of data needed to define the image without losing too much image quality [11].

After using DCT we will get the single image which will define the different structures which we are used for detection.

7. PCA

A new technique created two-dimensional principal component analysis (2DPCA) is developed for image demonstration. As opposed to PCA, 2DPCA is based on 2D image conditions rather than 1D path so the image background does not need to be converted into a vector proceeding to feature removal. Instead, an image covariance atmosphere is constructed directly using the original image atmospheres and its eigenvectors are

derived for image feature removal. To test 2DPCA and estimate its performance, a series of experiments were achieved on three face image databases: ORL, AR, and Yale face databases.The gratitude rate across all trials was higher using 2DPCA than PCA

8.HMM

We define an embedded hidden Markov model (HMM)-based approach for face finding and recognition that uses an effective set of thought vectors acquired from the 2D-DCT constants. The embedded HMM can conservative the two dimensional data improved than the one-dimensional HMM and is computationally a smaller amount complex than the two-dimensional HMM. This model is suitable for face descriptions since it exploits an important facial characteristic: forward faces replacement the same structure of "super states" from top to bottom, and also the same left-to-right structure of "states" inside each of these "super states.*"*

9. SVM

In machine learning, support vector machines (SVMs, also support vector networks) are supervised learning reproductions with related knowledge algorithms that examine data and diagnose patterns, used for arrangement and reversion analysis. Given a set of exercise examples, each noticeable as belonging to one of two categories, an SVM training algorithm builds a perfect that assigns new samples into one category or the other, making it a non-probabilistic binary direct classifier.

10. Skeletonization

Skeletonization is an process that is performed in order to get the center of an image. Knowing the center of the image or minimum is useful because the original image can be re-formed from it. The smallest of an object is theoretically defined as the locus of middle pixels in the object. Therefore, smallest is used to find out interior construction of the image. This image is a disposed to image. It is particular useful to find out boundaries, small and big dots correctly which we essential for recognition of diseases. Edges and dots will represent us blood container and exudates, hemorrhages of retinal image. These are different feature used for recognition of retinal image.

11. Diabetic Retinopathy DR is divided into various stages. The initial signs of DR are micro aneurysms (MA), dot & blot hemorrhages (HE), cotton-wool spots and exudates that outcome from irregular permeability and non-perfusion of capillaries. These initial signs are known as non-proliferative DR (NPDR). Fluid leaking from retinal vessels indicates a further advancement of the disease. This may lead to sight aggressive diabetic retinopathy, if the outflow is located in the area of most serious vision, the macula. Advanced stage of DR, proliferative DR (PDR), develops from blocked vessels that lead to retinal ischemia and creation of new containers on the surface of the retina either near optic disc (OD) or in the retinal periphery [21]
In 2015, 415 million adults suffered from diabetes mellitus [22]. This number is increasing, and by 2040, it is probable to reach 642 million. Long-time diabetes touches the blood containers also in the eyes, causing diabetic retinopathy (DR). In the case of DR, the blood containers providing the retina may develop thick and weak; causing leaks called hemorrhages (see Fig. 7).

12. Diabetic Retinopathy Detection

Some of the Eye Exams performed on the diabetic patients are as follows:

12.1Visual Acuity Measurement

It measures the eye's ability to focus at different distances [12].

12.2. Ophthalmoscopy and Slit Lamp Exam

These tests allow doctor to sight the back of the eye and arrangements including blood containers, nerve packages, and fundamental layers within the eye. These can be used to identify the blurring of the lens (cataract), changes in the retina, and other problems.

12.3 Optical Coherence Tomography

It is an imaging process to get high-resolution images of the retina and the central segment of the eye, to define the width of the retina or the existence of swelling within the retina.

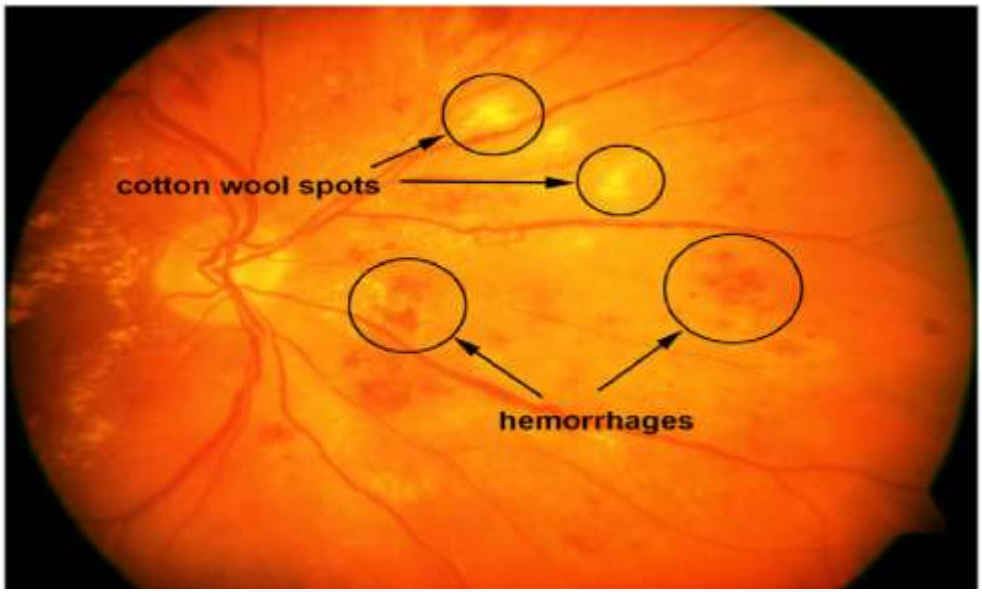

Fig. 7.A sample retinal image with cotton wool spots and hemorrhages

This method is also being used by cardiologists seeking to develop methods to check for fluid in your retina [13, 15,16].

12.4 Fundus Photography

Any procedure resulting in a 2-D image, where the image strengths illustrate the amount of a reflected quantity of light is known as fundus imaging and when for an exact waveband image strengths denote the amount of replicated light then it is called fundus photography. Fundus photography gives particular images of the back of the eye (the fundus). An eye doctor can compare images taken at dissimilar times to see the movement of the disease and appearance how well treatment is working [14, 15].

12.5 Fundus Fluorescein Angiography It is used to patterned for and locates any leaking blood containers in the retina of diabetic patients displaying symptoms that recommend damage to or swelling of the retina, can readily validate the range and position of vessel drop out [15].

4. Automatic Detection of Fovea

Automatic detection of Diabetic Retinopathy (ADDR) is a completely robotic system for detection of Diabetic Retinopathy (DR). Fovea is the supreme necessary part of the retina for human vision. If the delicate shafts of our fovea are damaged the person may be blind. The size of fovea zone in fundus eye image regulates whether it may main to various diseases, which may turn out to loss of sight. Fovea is categorized by the middle of the macula. In fundus retinal image the macula is the shadiest part approximated by a circle. Geometrically fovea is at a distance 2.5 times the diameter of the Optic Disk (OD) from its center [17].

13.Support Vector Machine Classifier

The computation cost concentrated by engaging the well-known SVM classifier for indexing the medical images constructed on their modality. During the recovery phase and feedback phase only a specific class of the databank images are edited. At the start of the retrieval procedure the unlabeled medical databank images are considered by using SVM classifier constructed on the hyper plane based on the conclusion function which can be a linear and nonlinear hyper plane which maps the nonlinear feature space into linear space by using kernel [23].

14. Fuzzy Classification:

Grouping elements into a set which are activated by a function or a set of functions defined is called 'classification' and if the elements are grouped into a fuzzy set with the relationship function defined by the truth value of a fuzzy propositional function , the procedure is called as 'fuzzy classification'.

The goal is to sort the image using fuzzy logic and hence the input data must be same. Fuzzy logic is the superset of the standard Boolean logic. In other sense, in fuzzy logic if the fuzzy values take 1 and 0 for entirely true and entirely false respectively, the logic come together to Boolean logic. That is for example X AND Y operator in Boolean logic is exchanged with min (X,Y) operator ; X OR Y with max (X,Y) and NOT X with 1-X.[25]

IV. Conclusion

In case of detection of disease of eyes using soft computing technique by using Iris tumor detection system(ITDS),Eye tumor detection system, support machine classifier, Fuzzy logic we will recognize the skin tumor and also increases the identification rate of diseases by the images of eyes.

[1]. L. Giancarlo, F. Meriaudeau, T. P. Karnowski, Y. Li, K. W. Tobin, Jr., and E. Chaum, "Automatic retina exudates segmentation without a manually labeled training set," in Proc. 2011 IEEE Int. Symp. Biomed.Imag: From Nano to Macro, Mar. 2011, pp. 1396–1400.

[2]. K. Huang and M. Yan, "A local adaptive algorithm for micro aneurysms detection in digital fundus images," in Proc.CVBIA, 2005, pp. 103–113.

[3]. M. R. Hee, C. A. Puliafito, C. Wong, J. S. Duker, E. Reichel, B. Rutledge,J. S. Schuman, E. A. Swanson, and J. G. Fujimoto, "Quantitative assessment of macular edema with optical coherence tomography, "Arch. Ophthalmic., vol. 113, no. 8, pp. 1019–1029, Aug. 1995.

[4]. J. Davidson, T. Ciulla, J. McGill, K. Kles, and P. Anderson, "How the diabetic eye loses vision," *Endocrine*, vol. 32, pp. 107–116, Nov. 2007.

[5]. A. D. Fleming, S. Philip, K. A. Goatman, J. A. Olson, and P. F. Sharp, "Automated micro aneurysm detection using local contrast normalization and local vessel detection," IEEE Trans.Medical Imaging, vol. 25, no. 9,pp. 1223–1232, 2006.

[6]. Li Helen K, Horton Mark, Bursell Sven-Erik, Cavallerano Jerry, Zimmer-GallerIngrid, Tennant Mathew, et al. Telehealth practice recommendations for diabetic retinopathy. 2nd ed. United States: Telemedicine and e-Health; 2011.

[7]. Gowthaman R," Automatic Identification And Classification of Micro aneurysms For Detection of Diabetic Retinopathy"IJRET: International Journal of Research in Engineering and Technology eISSN:2319-1163.,pISSN: 2321-7308 Volume: 03 Issue:02., Feb-2014

[8]. Paintamilselvi1, Shyamala, "A Novel Method To Detect The Fovea of Fundus Retinal Image",International Journal for Research and Development in Engineering (IJRDE) www.ijrde.com Vol.1: Issue.1, June-July 2012 pp- 21-25

[9]. Mohamed Ali David Claus "Using The Canny Edge Detector for Feature Extraction and Enhancement of Remote Sensing Images", Systems Design Engineering, University of Waterloo, IEEE 2001.

[10]. HaneneTrichili, Mohamed-SalimBouhlel, Nabil Derbel, LotfiKamoun,"A Survey and Evaluation of Edge Detection Operators Application to Medical Images" IEEE, 2002.

[11]. BhawanaTewari,SonaliDubey"Compression Analysis Between DWT And DCT"Department of ECE,Newdelhi 2005

[12]. Keith P. Thompson, Qiushi S. Ren, Member, IEEE, and Jean-Marie Parel "Therapeutic and Diagnostic Application of Lasers in Ophthalmology".

[13]. R.K.Ghanta, W. Drexler, U. Morgner, F. Kartner, F.P Ippen, J.G.Fujimoto, J.S. Schuman, A. Clermontt, S.Bursell, "Ultrahigh resolution retinal imaging with optical coherence tomography",CLEO 2000

[14]. Zhuo Zhang, FengShou Yin, Jiang Liu, Wing Kee Wong, NganMeng Tan, BengHai Lee, Jun Cheng, Tien Yin Wong,"ORIGA-light:An Online Retinal Fundus Image Database for Glaucoma Analysis and Research",32nd Annual

[15]. International Conference of the IEEE EMBS Buenos Aires, Argentina, August 31 - September 4, 2010.Michael D. Abràmoff, Senior Member, IEEE, Mona K. Garvin, Member, IEEE, and Milan Sonka, Fellow,"Retinal Imaging and Image Analysis", IEEE IEEE Reviews inbiomedical Engineering, VOL. 3, 2010

[16]. ArulmozhivarmanPachiyappan,Undurti N Das, Tatavarti VSP Murthy and RaoTatavarti,"Automated diagnosis of diabetic retinopathy andglaucoma using fundus and OCT images", Pachiyappan et al. Lipids in Health and Disease 2012, 11:73 http://www.lipidworld.com/content/11/1/73

[17]. J.JenitaJeba Esther1, S.G.Gino Sophia2 "Detecting\ Optic Disc In Digital Fundus Images Using Stochastic Watershed Transformation" IJREAT International Journal of Research in Engineering & Advanced Technology, Volume 2, Issue 1, Feb-Mar,2014. ISSN: 2320 – 8791

[18]. R.C. Gonzalez, R.E. Woods, Digital Image Processing, Addison Wesley,Reading, MA, 1992.

[19]. ParthPanchala, RonakBhojanib, TejendraPanchalc An Algorithm for Retinal Feature Extraction using Hybrid Approach page 63 ParthPanchal et al. / Procedia Computer Science 79 (2016) 61 – 68

[20]. B. Liesenfeld, E. Kohner, W. Piehlmeier, S. Kluthe, M. Porta, T. Bek, et al., A

[21]. Jelinek H.F., Cree M.J..Automated Image Detection of Retinal Pathology. ISBN 978-0-8493-7556-9

[22]. Aguiree F, Brown A, Cho NH, Dahlquist G, Dodd S, Dunning T. et al. IDF diabetes atlas. 7Th ed. ed., International Diabetes Federation.; 2015.

[23]. B.Jyothia, Y.MadhaveeLathab, P.G.KrishnaMohanc ,V.S.K.Reddyd Integrated Multiple Features for Tumor Image Retrieval Using Classifier and Feedback Methods. International Conference on Computational Modeling and Security (CMS 2016) pp-4

[24]. Nimmythomas,Therese Yamuna Mahesh, Detection and Classification of Exudates in Diabetic Retinopathy, Volume 2, Issue 9, September 2014ISSN: 2321-7782 pp-297

[25]. Goli Haveesh1, GovardhanHegde K, Bhargav J Bhatkalkar,SrikanthPrabhu, SulathaBhandary,Glaucoma detection and its classification using image processing and fuzzy classification,4th World Conference on Applied Sciences, Engineering & Technology 24-26 October 2015,Kumamoto University, Japan, ISBN 13: 978-81-930222-1-4, pp 291-295

[26]. Rodrigo Veras(2015), Romuere Silva, Fl´avioAra´ujo,F´atima Medeiros, "SURF descriptor and pattern recognition techniques in automatic identification of pathological retinas",2015 Brazilian Conference on Intelligent Systems.

[27]. ManojKumar S. B. ,Manjunathand R. and Dr. H S Sheshadri, " Feature extraction from the fundus images for the diagnosis of diabetic retinopathy",International Conference on Emerging Research in Electronics," Computer Science and Technology – 2015

[28]. A. Pentland, B. Moghaddam and T. Starner, "View-based and modular eigen spaces for face recognition", Proceedings of the IEEE International Conference on Computer Vision and Pattern Recognition, Seattle, WA, **(1994)**, pp. 84-91.

[29]. J. Huang and H. Wechsler, "Eye Detection Using Optimal Wavelet Packets and Radial Basis Functions (RBFs)", International Journal of Pattern Recognition and Artificial Intelligence, vol. 13, no. 7, **(1999)**.

[30]. K. Talmi and J. Liu, "Eye and Gaze Tracking for Visually Controlled Interactive Stereo scopic Displays", Signal Processing: Image Communication, vol. 14, **(1999)**, pp. 799-810, Berlin, Germany.

[31]. A. Torii and A. Imiya, "The Randomized Hough Transform Based Method for Great Circle Detection on Sphere", In the Proceedings of Pattern Recognition, **(2007)**, pp. 1186-1192.

[32]. Eye Cancer Foundation. Iris tumors. http://www.eyecancer.com/research/image-gallery Accessed 20 November 2014.

[33]. Albert DM, Kulkarni AD. Intraocular Melanoma. In: DeVita VT, Jr., Lawrence TS, Rosenberg SA (eds) Cancer: Principles and Practice of Oncology. 3rd ed. Lippincott Williams&Wilkins. Philadelphia; 2011: 2090-2098.
[34]. Miles Research, available: http://www.milesresearch.com/main/links.htm.
[35]. James Church, Dr. Yixin Chen, and Dr. Stephen Rice, "A Spatial Me-dian Filter for Noise Removal in Digital Images".Southeastcon, 2008. IEEE, p.p.618 – 623
[36]. Milan S, Vaclav H, Roger B. *Image Processing, Analysis, and Machine Vision*. 2nd edn.Pws Publishing, Pacific Grove, CA; 1998.