IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

AN ENHANCED IMAGE PROCESSING SYSTEM FOR DIABETIC RETINOPATHY STUDY OF SEVERE AFFECTED DIABETICS PATIENTS

[1]*Ms.Sridevi.T*, [2] *Dr.K.Seetharaman*

[1] *Research Scholar*, [2]*Associate Professor and Head,*

[1]*Department of Computer Science,*

[1]*Bharathiyar University*, Coimbatore, India

[2]*Computer Science and Engineering Wing*,DDE

[2]*Annamalai University*, Annamalai Nagar, India

Abstract: This paper presents diagnosis of diabetic retinopathy affected diabetic patients using image processing methods. To study recent algorithms related to Image Enhancement (Morphological enhancement-Fusion Morphological Reconstruction (FMR)) and Segmentation (Morphological Watershed and Fast Marching Algorithm) to solve the problem and attempt to modify the algorithm for specific application. To establish an Improved efficient fusion approach as said in title of the topic by combining the image processing (Enhancement and segmentation) techniques as per requirements and also to tabulate statistical comparison of image attributes. To explore and investigate the significance of less commonly used estimate parameters in process of medical image analysis. To develop a frame work for qualitative automatic medical imaging to detect and forecast the irregularity in the considered problem for accurate diagnosis. In addition, we have developed a novel algorithm for the parallelization of the fast marching method which uses the time warp approach to parallel discrete event simulation. The new algorithm has been implemented using the message passing interface (MPI), enabling it to run on distributed memory machines.This is very useful for diabetic retinopathy affected diabetic patients and monitoring the affected range of eyesight.

***Index Terms* - Diabetics, Diabetic Retinopathy, Image Processing.**

I.INTRODUCTION

Diabetes mellitus (DM), ordinarily called polygenic disorder, may be a cluster of metabolic disorders characterized by a high blood glucose level over a protracted amount. Symptoms of high blood glucose embody frequent urination, exaggerated thirst, and exaggerated hunger.

If left untreated, polygenic disorder will cause several complications. Acute complications will embody diabetic diabetic acidosis, hyperosmolar hyperglycemic state, or death. Serious long complications embody upset, stroke, chronic kidney disease, foot ulcers, and damage to the eyes. Diabetes is thanks to either the exocrine gland not manufacturing enough endocrine, or the cells of the body not responding properly to the insulin produced.

There are three main types of diabetes mellitus:

• **Type 1** diabetes results from the pancreas's failure to produce enough insulin due to loss of beta cells. This form was antecedently observed as "insulin-dependent diabetes mellitus" (IDDM) or "juvenile diabetes”. The loss of beta cells is caused by an autoimmune response. The cause of this autoimmune response is unknown.

• **Type 2** diabetes begins with insulin resistance, a condition in which cells fail to respond to insulin properly. As the malady progresses, a lack of insulin may also develop. This form was antecedently observed as “non insulin-dependent diabetes mellitus" (NIDDM) or "adult-onset diabetes”. The most common cause is a combination of excessive body weight and insufficient exercise.

• **Gestational** diabetes is the third main form, and occurs when pregnant women without a previous history of diabetes develop high blood sugar levels.

II. DIABETIC RETINOPATHY

Diabetic retinopathy could be a polygenic disorder complication that affects eyes. It's caused by injury to the blood vessels of the photosensitive tissue at the rear of the attention (retina).At first; diabetic retinopathy could cause no symptoms or solely gentle vision issues. Eventually, it can cause blindness. The condition can develop in anyone who has kind one or kind two inherited disease. The longer you have got polygenic disorder and also the less controlled your glucose is, the additional probably you're to develop this eye complication.

Symptoms

You might not have symptoms within the early stages of diabetic retinopathy. As the condition progresses, diabetic retinopathy symptoms could include:

- Spots or dark strings floating in your vision (floaters)
- Blurred vision
- Fluctuating vision
- Impaired color vision
- Dark or empty areas in your vision
- Vision loss

Diabetic retinopathy usually affects both eyes.

Causes

Over time, an excessive amount of sugar in your blood will cause the blockage of the little blood vessels that nourish the membrane, separating its blood provide. As a result, the attention makes an attempt to grow new blood vessels. But these new blood vessels do not develop properly and may leak simply.

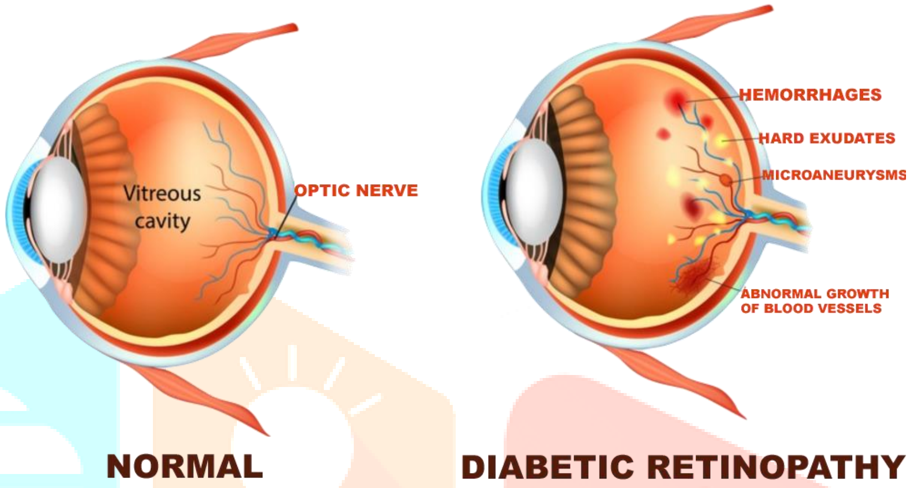

Figure 1: Diabetic Retinopathy

There are two types of diabetic retinopathy:

- Early diabetic retinopathy.
- Advanced diabetic retinopathy

Complications

Diabetic retinopathy involves the abnormal growth of blood vessels in the retina. Complications can lead to serious vision problems:

•**Vitreous hemorrhage**. The new blood vessels may bleed into the clear, jelly-like substance that fills the center of your eye. If the amount of bleeding is small, you might see only a few dark spots (floaters). In more-severe cases, blood can fill the vitreous cavity and completely block your vision.

Vitreous hemorrhage by itself usually doesn't cause permanent vision loss. The blood often clears from the eye within a few weeks or months. Unless your retina is damaged, your vision may return to its previous clarity.

•**Retinal detachment**. The abnormal blood vessels associated with diabetic retinopathy stimulate the growth of scar tissue, which can pull the retina away from the back of the eye. This may cause spots floating in your vision, flashes of light or severe vision loss.

•**Glaucoma**. New blood vessels may grow in the front part of your eye and interfere with the normal flow of fluid out of the eye, causing pressure in the eye to build up (glaucoma). This pressure can damage the nerve that carries images from your eye to your brain (optic nerve).

•**Blindness**. Eventually, diabetic retinopathy, glaucoma or both can lead to complete vision loss.

III.WATERSHED SEGMENTATION

The main objective of the image segmentation is the grouping and classification into the homogenous subgroups of the data with respect to one or more properties and attributes. An eminent image segmentation method is morphological watershed transform, based on mathematical morphology to partition an image due to discontinuities. Watershed segmentation is a method for partitioning a gray-scale image into regions, based on the topology of the image. The theory of watersheds is envisioning an image in a three dimensional plot with two spatial co-ordinates against intensity. Three points have to be considered in such a topographic version given as

(a) Points belonging to regional minimum

(b) Points at which a drop of water, if placed at the location of any of those points, would fall with certainly to a single minimum and

(c) Points at which water would be equally likely to fall to more than one such minimum.

Particularly for a regional minimum, the set of points fulfilling condition (b) is labeled as catchment basin or watershed of that minimum. Watersheds in simple words can be expressed as a place formed for the purpose storage of rain water. The points fulfilling condition (c) form crest lines on the topographic surface and are named divide lines or watershed lines

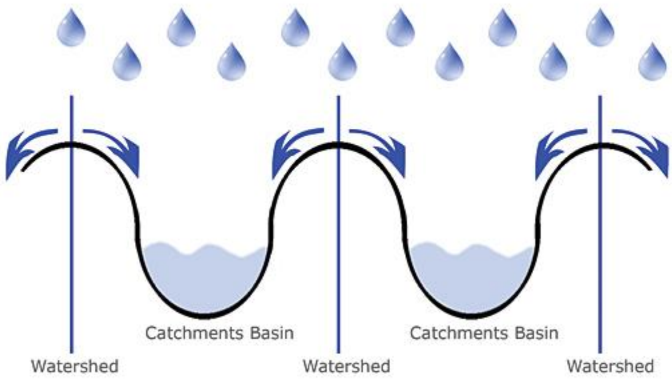

Figure .2 Watershed representation

The primary purpose of watershed segmentation algorithms is to locate watershed lines. Once these lines are located successfully the watershed can be easily outlined. The fundamental idea is straightforward; presume that a hole is punched in each regional minimum and that the complete topography is flooded from below by allowing water rise through the holes at uniform rate. Further a dam is built whenever the rising water in distinct watersheds is about to amalgamate in order to prevent the damage. The overflow will sooner or later reach a stage when only the tops of the dams are observable above the waterline. The watersheds are isolated by lines by the corresponding boundaries of Dam. Consequently watershed algorithm extracts the connected boundaries. In contrast to traditional area based segmentation, the watershed transform is implemented on the gradient image. Gradient Image is the result of applying differential procedure on original image.

Watershed algorithm :

- Let M1, M2, M3….Mn be the sets of coordinates of points in the regional minima of the image g(x,y)
- C(Mi) be the coordinates of points of the catchment basin associated with regional minima Mi
- T[n] = { (s,t) | g(s,t) < n }
- T[n] = Set of points in g(x,y) which are lying below the plane g(x,y) = n
- n = Stage of flooding, varies from min+1 to max+1
- min = minimum gray level value
- max = maximum gray level value

Let Cn(M1) be the set of points in the catchment basin associated with M1 that are flooded at stage n.

Cn(Mi) = C(Mi) ∩ T[n]
Cn(Mi) = 1 at location (x,y) if (x,y) Є C(Mi)
AND (x,y) Є T[n], otherwise it is 0
C[n] be the union of flooded catchment basin portions at the stage n
C[n] = URi-1 Cn (Mi)
C[max + 1] = URi-1 C(Mi)

Algorithm keeps on increasing the level of flooding, and during the process Cn (Mi) and T[n] either increase or remain constant. Algorithm initializes C[min +1] = T[min+1], and then proceeds recursively assuming that at step n C[n-1] has been constructed.

Let Q be set of connected components in T[n].

For each connected component q Є Q[n], there are three possibilities:

(a) q ∩ C[n-1] is empty (q1) A new minimum is encountered q is incorporated into C[n-1] to form C[n]

(b) q ∩ C[n-1] contains one connected component of C[n-1] (q2) q is incorporated into C[n-1] to form C[n]

(c) q ∩ C[n-1] contains more than one connected components of C[n-1] (q3)

Subsequent to segmentation procedure, the borders of the watershed regions are set on the desired ridges, thus separating each object from its neighbors.

IV. PROPOSED WORK

The implemented method shown in above is used to enhance and segment the medical image. Here Hybrid Morphological Reconstruction (HMR) technique is used to enhance the medical images, and Morphological segmentation for classification of the enhanced medical images.

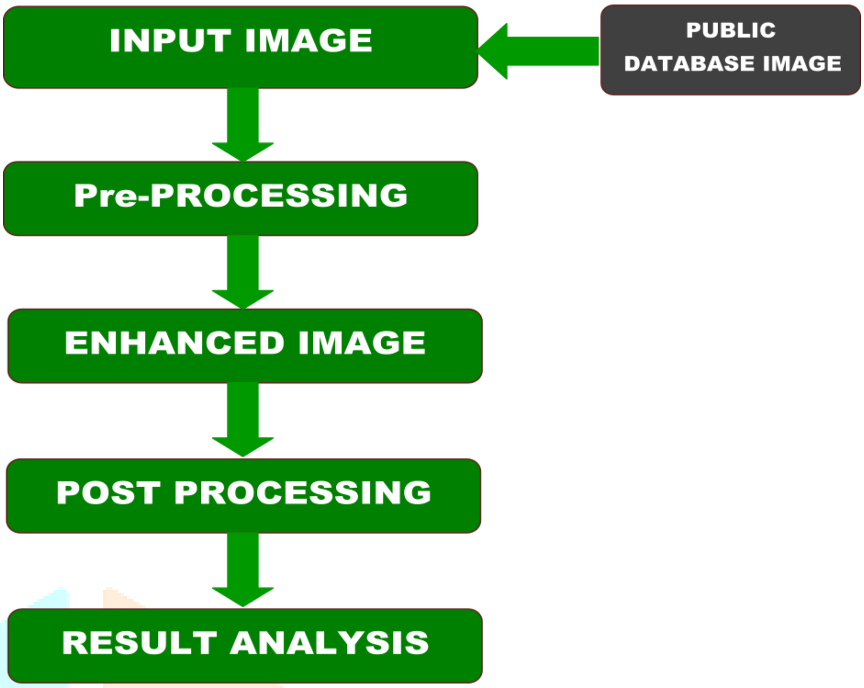

Figure.3 Implemented Model Block Diagram

Model description

The images that are obtained from the Public Image Database which are related to Diabetes Mellitus are considered as the input images. The images chiefly taken into work here are of cross section of the Right Coronary Artery (RCA), retinal images with various anomalies and axial & Coronal fat-suppressed T2-weighted MRI images. Generally the images are RGB images. So the RGB images are processed using the MATLAB software and the images undergo several algorithms to get a better output. Initially the RGB image is converted into grey scale to avoid complex calculations. Next step is to perform the Gradient Magnitude segmentation function. After the above two steps are finished then the main step, watershed transform segmentation is performed. Watershed transform is the region base segmentation method. In this step it fills the gaps present in the images and finally the analyzing the result.

Methodology

The Methodology is given below as a step by step procedure to solve the considered Model.

a. Medical visual data base collection:

Acquiring the images (Retinal images, Electron micrographs and MRI) from Online Public Database and also from Diabetic research institutes (took help from Dr. Mohan's Diabetes Specialities Centre,Chennai,TamilNadu) The visual data consists of varied databases with documents of differing modalities and varying characteristics.

b. Implementation of algorithms:

The image enhancement and segmentation algorithms discussed in proposed model are implemented based on their logical computations using MATLAB technical computing language (R2010a version and above) using toolboxes image acquisition, image processing, fixed point and neural networks.

c. Testing:

The proposed algorithm tested on the collected medical visual data base and important features from extensive testing have been extracted.

d. Analysis:

Using the results of the tests, an assessment of the algorithm is made. Therefore an analysis is carried out on a normal group (DM) and abnormal group (DM with DR, Cardiac Problems, and Myonecrosis). The results are compared with the clinical characteristics for a certain period of time taking the help of medical community. Any relative strengths or weaknesses of algorithms should be found.

e. Modified algorithm:

Based on the analysis, one or more improvements to existing recent Image enhancement and segmentation techniques have become apparent. Thus a new algorithm is devised namely Improved Hybrid Model (IHM) which demonstrates the improvements.

f. Test modified algorithm:

The improved algorithm is evaluated on the basis of the requirements to analyze the abnormalities in an easiest way.

g. Outcome:

Finally the research project resulted in the creation of a new algorithm that combined ideas from the existing image processing techniques and was useful to attain the motto.

Implementation of the proposed method

In this research the input images acquired from various public databases were simulated using MATLAB (Matrix Laboratory), a high-level Technical Computing language (R2010a version and above) on an Intel Core i5 PC at 2.5GHZ with a total physical memory of 4 GB RAM. There are more than 100 toolboxes available in Matlab, but only a few such as image acquisition, image processing, fixed point and neural networks tool boxes have been utilized. Matlab is a trademark product of Mathworks Inc. which allows matrix manipulations.

Another state-of-art tool MIPAV (Medical Image Processing, Analysis, and Visualization) which is an open source is utilized to extract the attributes of significance from the images. These attributes are constructive in elucidation of the abnormalities in precise style. The main feature which makes the researcher to use MIPAV is its applicability even on 3D images and quantification aspect. MIPAV is a Java application and can run on any java enabled PCs. This is the product of Center for Information Technology, National Institutes of Health, Bethesda.

V. EXPERIMENTAL INVESTIGATIONS

The images of the diabetic retinopathy (DR) come with the problems such as hard exudates, soft exudates, micronaneuyrysms, hemorrhages and neovascularization. In this work three images (Courtesy to the Public data base from which images were acquired are given below the original images) have been considered with combination of above said problems to analyze the detected results obtained. All the resultant images from the proposed method are not useful for analysis and thus only the images which show up the above said problems after processing are considered.

Figure. 4. Hard Exudates and hemorrhage (Courtesy: Illinois Retina & Eye Associates)

The Figure.4 represents DR image with hard exudates and hemorrhages and is fed to the proposed hybrid model. The first stage result is simple inverted image (Grayscale Image) shown in Figure.5 yields mainly the hard exudates with a change in the intensity value.

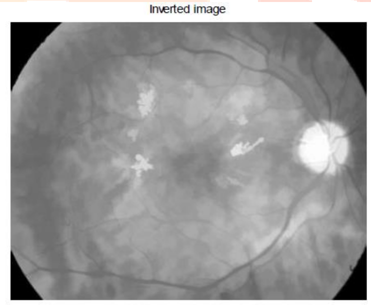

Figure. 5 Inverted Image

Whereas Figure.6 is a gradient magnitude image which shows the clear separation of hard exudates from the background represented as round lesions.

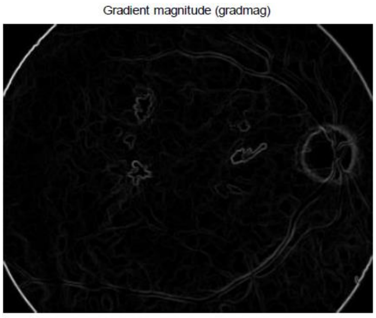

Figure. 6. Gradient Magnitude

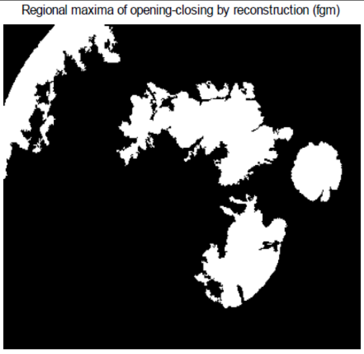

Figure. 7. Image reconstruction by regional Maxima

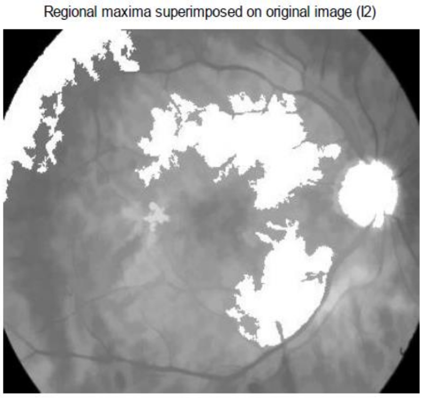

Figure. 8. Superimposed image

The resultant images from Figures.6 to 8 mainly visualize the presence of hemorrhage in the DR image which can be easily perceived from appearance of the images. The output images contain particular ROIs (Region of Interest) with a change in the intensity value.

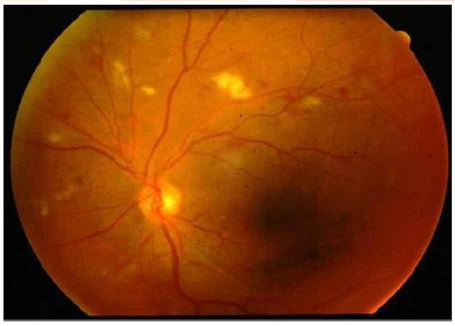

Figure. 9. Retinal hemorrhage and soft exudates
(Courtesy: Graduate School of Medical Sciences, Kunamoto University, Japan)

The Figure.9 represents an image with hemorrhages and soft exudates and is fed to the proposed hybrid model. The first stage result is simple inverted image (Grayscale Image) shown in Figure.10 yields the soft exudates as well as hemorrhage (visible in black shaded region) with a change in the intensity values.

Whereas Figure.11 is a gradient magnitude image which shows the clear separation of soft exudates (wool spots) from the background. These wool spots are of clinical significance that they shall be attended for medical emergency otherwise there are more chances of losing visibility.

Figure. 10. Inverted image

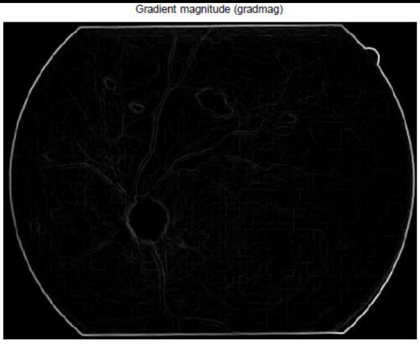

Figure. 11. Gradient Image

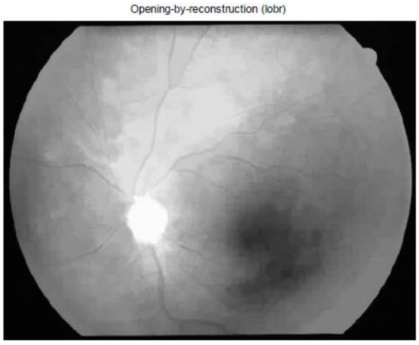

Figure. 12.Opening by Closing

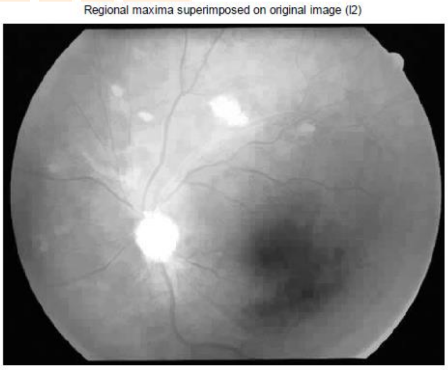

Figure. 13.Superimposed image showing soft exudates (wool spots)

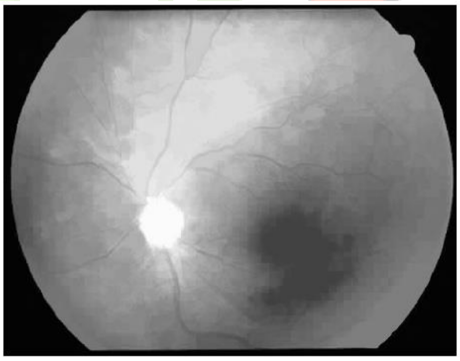

Figure. 14..Reconstruction using Opening by Closing

The resultant images from Figures 12 to 14 mainly visualize the presence of soft exudates (in form of wool spots from Figure .14.) and hemorrhage in the DR image which can be easily perceived from appearance of the images. The output images contain particular ROIs (Region of Interest) with a change in the intensity value.

The Figure.15 represents an image with Micronaneuyrysms and hemorrhages and is fed to the proposed hybrid model. A small region of blood protrusion from an artery or vein in retinal part of eye is called as retinal microaneurysm. This condition might result in leakage of blood into tissues adjoining by damaging the vision. The first stage result is simple inverted image (Grayscale Image) shown in Figure.16. yields only hemorrhage(visible in black shaded region) with a change in the intensity values.

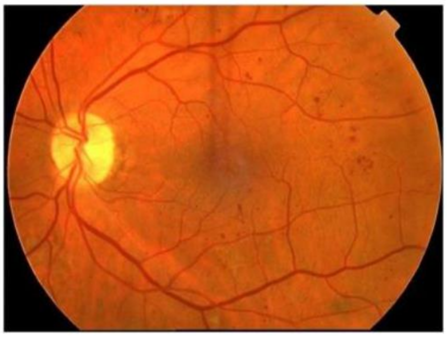

Figure. 15. Microaneurysm and hemorrhages
(Courtesy: Retina Consultants, NSW)

Figure. .16.Inverted image

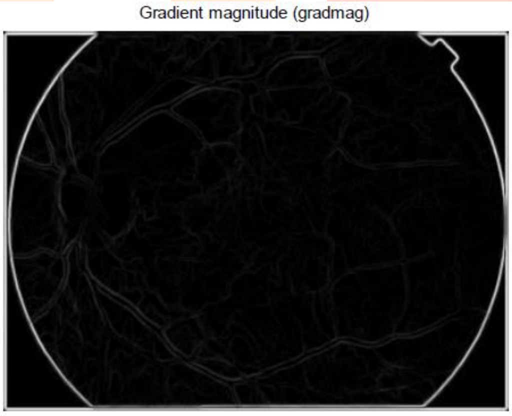

Figure. 17.Gradient Magnitude image

Whereas Figure.17 is a gradient magnitude image which shows Micronaneuyrysms which are visible as tiny spots which are scattered though out the eye as threads. This condition may lead to much more difficulties to the patients in making their daily lives miserable and finally may finally lead to visual morbidity.

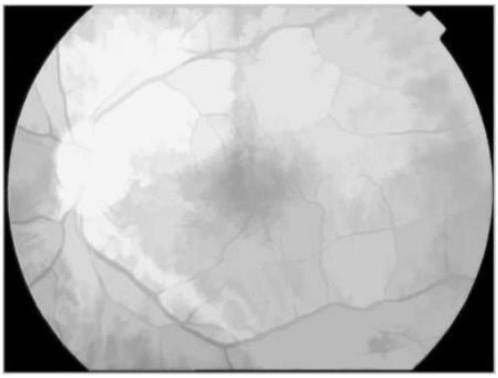

Figure.18.Reconstruction by opening

The image reconstruction by opening shows the centre part of Figure.18 contain hemorrhage in the DR image which can be easily perceived from appearance of the images.

VII. CONCLUSION AND FUTURE SCOPE

Conclusion

From the experimental investigations, it is observed that a lot of imaging methodologies work is implemented on Diabetic Retinopathy. However it is a challenge to the researchers to put lot of efforts to investigate on other related problems. The work is mainly dealt with images related to Diabetic Retinopathy i.e. problems such as hard exudates, soft exudates, microaneurysms and hemorrhages; these are clearly explained with the help of obtained results .The simulation results achieved using proposed method implies that early stage detection avoids the loss of vision.

The simulation results are useful in educating common people and explaining them the risk of neglecting Diabetes and its complications.

Future Scope

On a technical note in future development other new pre-processing algorithms combined with Watershed algorithms can give perspective results so that it can assist Endocrinologists, Ophthalmologists and Cardiologists for earlier detection of Diabetes and its related problems, for easy analysis and to study the pathologies.

REFERENCES

[1] Sharifi. A, Vosolipour.A, Aliyari Sh.M, Teshnehlab.M ―Hierarchical Takagi-Sugeno Type Fuzzy System for Diabetes Mellitus Forecasting‖ Proceedings Of 7th Int. Conf. on Machine Learning and Cybernetics, Kunming, Vol. 3,pp.1265 – 1270, 12-15th July 2008.

[2] Alireza Osareh, Bita Shadgar, and Richard Markham ―A Computational-Intelligence-Based Approach for Detection of Exudates in Diabetic Retinopathy Images‖ an IEEE transactions on Information Technology In Biomedicine, Vol. 13, No. 4, pp. 535-545, July 2009.

[3] Rafael C. Gonzalez, Richard E.woods ―Digital Image Processing‖, Addison-Wesley, An imprint of Pearson Education, 1st Edition, 2002.

[4]Intajag, S.; Tipsuwanporn, V.; Chatthai, R Chatree ―Retinal Image Enhancement In Multi-Mode Histogram‖ 2009 World Congress on Computer Science and Information Engineering, Vol. 4, pp. 745-749,
Mar 2009

[5] Tirupati Goskula, Prof. Prasanna .M. Palsodkar ‖ Extracting Salient Region by Image Segmentation of Color Images Using Soft Computing Technique‖ proceedings of International Conference on Emerging Trends in Signal Processing and VLSI Design (SPVL- 2010),pp 515-519, INDIA, June 2010.

[6] M. Foracchia, E. Grisan, and A. Ruggeri*, Senior Member, IEEE ―Detection of Optic Disc in Retinal Images by Means of a Geometrical Model of Vessel Structure‖ an IEEE transaction on MEDICAL IMAGING, Vol. 23, No. 10, pp. 1188-1195,October 2004.

[7] Vijendra P. Meshram, Rajesh.D. Thakare, Prashant Wanjari, Vishwas V. Balpande, Ishan A. Patil ―Liver Segmentation using KMeans Algorithm and Mathematical Morphology,‖, International Journal of Advanced Research in Computer Science and Software Engineering, Volume 5, Issue 3, March 2015 ISSN: 2277 128X.

[8] Linda G. Shapiro and George C. Stockman , ―Computer Vision‖, pp 279-325, New Jersey, Prentice-Hall, 2001.(ISBN 0-13-030796-3).

[9] McAuliffe MJ, Lalonde FM, McGarry D, Gandler W, Csaky K, Trus BL. Medical Image Processing, Analysis & Visualization In Clinical Research. IEEE Computer-Based Medical Systems (CBMS) pp.381-386, 2001.