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A Novel Approach for Retina vessel detection using Genetic Algorithm Thresholding

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KEYWORDS

Genetic algorithm, Vessel detection, Segmentation, DCT, Optimization, Morphological operation, Fundus Image

A B S T R A C T

This is the research paper, which is foundation on the Retinopathy. Retinopathy is an eye disorder that is very familiarly related to diabetes. The occupied name is Diabetic Retinopathy, and can conduct to blindness because it causes the retina to twist out to be damaged. When blood sugar is too elevated damage can be throughout to the blood vessels, together with those in eyes. As rapidly this happens new blood vessels may assemble up over the retina causing lesion. In this paper we used a different technique for the appreciation of the blood vessel which is a Genetic algorithm thresholding. It's a very unique method in the course of which we can easily become conscious of the blood vessel from the retina. The method is weigh up on the publicly presented DRIVE,STARE and CHAISE_DBI. Initially apply Pre Filtering method, afterwards we dig out green part from RGB image subsequently DCT Filtering be appropriate the Genetic thresholding with block wise gridding at that moment the result will be compare with the different parameter like SN (Sensitivity), SP (Specificity), Acc (Accuracy), PPV (Positive predictive value), FDR (False data recorder)

Introduction

Retinopathy is an eye disorder that is very personally related to diabetes.DABETIC retinopathy is a most important cause of blindness affecting 95% of diabetics surrounded by 15 years of onset of whom 2% may become blind and 10% suffer harsh visual impairment. Annual screening is suggested to identify progression allowing untimely treatment, which may prevent up to 90% of belongings of blindness.Grading standards for screening include background and sight threatening retinopathy, the latter being predominantly important to detect reliably. The full name is Diabetic Retinopathy, and can guide to blindness because it causes the retina to turn into damaged. Retinopathy is an eye disorder that is very closely correlated to diabetes. The full name is Diabetic Retinopathy, and can lead to blindness because it causes the

retina to be converted into damaged. When your blood sugar is too soaring damage can be done to the blood vessels, as well as those in your eyes. Now days, diabetic retinopathy is a key cause for the blindness in elder age people. Patients who are suffering from diabetes are more probable to have eye disease but the main hazard to eye sight is effect on retina. To detect the diabetic retinopathy in diabetic patients, retinal images have to be analyzed. The representative Fundus Image looks like in the Figure 1. The vivid optic disc and vascular network can clearly seen in this image initially we will remove the background noise by from the retinal fundus image by using pre filtering performance. subsequent to using pre filtering technique and extract the RGB image from the second image, and we force work on the only green image for the reason that we can easily become aware of the vessel from the green image.then after this one we will apply the DCT filtering technique to remove the noise and the light effect from the green image. Then at the after everything else we will apply the Genetic algorithm thresholding and after compare it with the original image we will distinguish the different parameter, and shown it over the ROC curve with plotting.In accumulation we will evaluate this method with the other techniques and analyses by applying them with more image taken from DRIVE, STARE and CHAISE database.

Related method

The eye is a window to the retinal vascular system which is exclusively easily reached for the non-invasive, in vivo study of a incessant vascular in humans. The detection and measurement of blood vessels can be used to compute the harshness of disease, as part of the process of automated judgment of disease or in the evaluation of the effect of therapy. Retinal blood vessels have been shown to alter in diameter, branching angles or tortuosity, as a result of a disease, such as hypertension (6), diabetes mellitus or retinopathy of prematurity (ROP) (7). in addition, retinal arteriolar or venular changes expect development of hypertension (6,8), new inception diabetes (6), sequence to diabetic retinopathy (9) and development of diabetic renal disease (10). Thus a dependable method of vessel segmentation would be valuable for the early discovery and characterization of morphological changes.

A first approximation to the segmentation of retinal blood vessel by means of this approach was previously presented (11), where segmentation method was tested on a small image section without any corroboration. An extension of this work is presented here and the method is now knowledgeable on two local databases and two public databases of absolute manually labelled images (12,13). We evaluate our segmentation using the public databases that contain also used by other authors for the same reason (13,14). confirmation of segmented vessel diameters and branching angles capacity are also made: between red-free against shine in images and between our algorithm and one of the public databases.

Proposed method

More vessels are nearby in the green part of RGB image of retina so we too obtainable to implement our algorithm with green extraction of RGB image. We are obtainable to implement Genetic Algorithm with multiple thresholding with block wise gridding to get enhanced vessels output. Results will be taken with the comparison of ground truth of the image with output of the algorithm and evaluate the parameter. It's a very unique method through which we can

effortlessly detect the blood vessel from the retina.The method is evaluate on the publicly accessible DRIVE,STARE and CHAISE_DBI

Materials and Methods

Pre Filtering Technique

Pre filtering is a technique which is used for removing the background noise from the original image. first of all we will remove the background noise by from the retinal fundus image by using pre filtering technique.

Extraction of RGB Image

We all well know that is every images have primary colour i.e. Red, Blue and Green. Extraction is way to extract these all colour from the image. Extraction is the foremost part of Retinal images. The major work of the Retinopathy which is absolutely based upon blood vessel detection, the detection of blood vessel mostly done on the green part from the RGB colour. If we pull out the green part from the original image the vessel shown very obviously than the other part of the RGB colour. It's clearly we can see in the Fig 2 readily available is mining of RGB images but vessel easily seen in the green part,So we always do work of Retinopathy on the green part of the retinal image(10)

Apply DCT Filtering on the image

at the outset we have know about DCT Filtering, it's a course of action through which we can remove the Noise and the lighting effect from the image Digital images are often dishonoured by noise, due to the deficiency of the purchase system or the conditions during the purchase. Noise decreases the perceptual quality by masking considerable information, and also degrades performance of any dealing out applied over the acquired image. Hence, image profiteering is a common process used in order to improve analysis and interpretation of remote sensing, broadcast transmission, optical scanning, and other visualization data. Till now a huge number of different image filtering techniques have been designed including nonlinear non adaptive and adaptive filters, transform-based methods techniques based on self-determining component analysis, and primary component analysis (PCA),and so forth. These techniques have dissimilar compensation and drawbacks thoroughly discussed in,and other references. The request areas and conditions for which the use of these filters can be the most helpful and expedient depend on the filter properties, noise statistical quality, and the priority of requirements. For effective filtering, it is attractive to considerably suppress noise in homogeneous (smooth) regions and to preserve edges, details, and texture at the similar time. Acceptable computational cost is the most important condition that can put a ceiling on a practical applicability of some denoising techniques. From the position of noise control, protection of edges, details and texture, and time competence requirements, quite good usefulness has been established by nearby adaptive methods.The latest modifications of locally adaptive filters take account of both typical nonlinear scanning window filters (employing order statistics) and transform-based filters, in particular, filters based on discrete cosine transform (DCT).

Genetic Algorithm

GA is one of the helpful techniques in Artificial Intelligence which is based on the natural evolution to resolve look for and optimization difficulty. GA is a

straightforward method yet valuable in finding a sensible solution to a complex setback. GA is selected based on its computational effectiveness with less mathematical calculation and the capabilities of management large search space. An important characteristic of genetic algorithm is the coding of variables that describes the trouble. The most common coding technique is to transform the variables to a binary string or vector. This initial population formulation development is critical. This action is also recognized as encoding process. Genetic Algorithms (GA) are stochastic search algorithms that have access to some concepts from nature. GA maintains a population pool of candidate solutions called strings otherwise chromosomes. related with each chromosome is a fitness value which is resolute by a user denied function, called the fitness function. The function proceeds a magnitude that is proportional to the candidate solution's properly and/or optimality. At the start of the algorithm, an initial population is generate. Initial members of the population may be randomly generated, or generated according to a little rules. The reproduction operator selects chromosomes from the population to be parents for a innovative chromosome and enters them into the mating pool. Selection of a chromosome for parenthood can series from a totally random method to one that is base by the chromosome's Fitness. The cross-over operative oversees the mating practice of two chromosomes. Two parent chromosomes are certain from the mating pool randomly and the cross-over rate, which is a real quantity between zero and one, determines the probability of produce a new chromosome from the parents. If the mating was perform, a child chromosome is formed which inherits complementing genetic material from its parents. The cross-over operative decides. Genetic algorithms form an effective solution for optimization problems (19) and they can be well thought-out as probabilistic search algorithms (20). A GA will classically have five parts: (1) a representation of a guess called a chromosome, (2) a fitness function, (3) a selection function and (4) a crossover operator and a mutation operator. A chromosome can be a binary string or a more complicated data structure. The early pool of chromosomes can be randomly produced or manually shaped. The fitness function measures the suitability of a chromosome to meet a particular

Objective: The selection function decides which chromosomes will participate in the evolution stage of the genetic algorithm complete up by the crossover and mutation operators. The crossover operator exchanges genes from two chromosomes and create two novel chromosomes. The mutation operator changes a gene in a chromosome and creates one new chromosome. *Pseudo Code For Genetic algorithm*

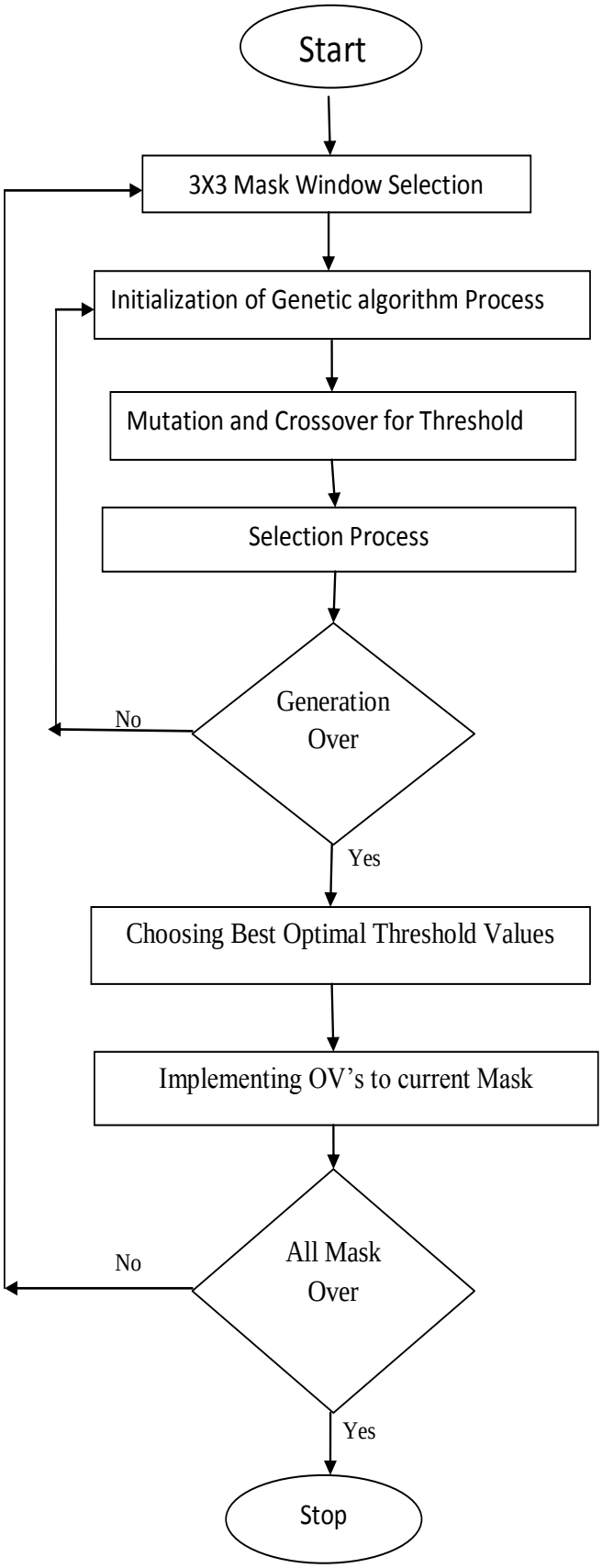
For i=1 to r
For j=1 to C
C_{ij} =I (i: i+2, j: j+2)
OV = GA (C_{ij}) j

$$\text{I Logical} = \begin{cases} 1, \text{ if } OV_1 > C_{ij} < OV_2 \\ 0, \text{ Otherwise} \end{cases}$$

End for

- Where r & c are the dimension of image.
- OV represent the optimal value for GA.
- I Logical is logical image of mask.
- C_{ij} is the i^{th} row & j^{th} column of mask.

a. Flow Chart


Start
3X3 Mask Window Selection
Initialization of Genetic algorithm Process
Mutation and Crossover for Threshold
Selection Process
Generation Over
No
Yes
Choosing Best Optimal Threshold Values
Implementing OV's to current Mask
All Mask Over
No
Yes
Stop

at the outset regarding the image divided into 3X3 Mask To initialize the Genetic Process we have generate Generation is 50, Chromosome is 100. Step size (-10 to 10), search limit (0-255).

The basic steps of a Genetic algorithm are as follows:

Step 1: at the outset regarding the image divided into 3X3 Mask To initialize the Genetic Process we have generate Generation is 50, Chromosome is 100. Step size (-10 to 10), search limit (0-255)

Step 2: **Initialization of GA (Parent):** move towards up with a method to represent the data (data being the person properties/characteristics that make up an individual element), these person pieces of the data can be termed **genes**. Determining how to symbolize the genes is a big part of prepare your GA. The genes can be a progression of binary values, string characters, or other array of elements, that indicate to more complex data structures. To get a practical idea of what this means, see how the persons at represented their genes.

To **c**reate an initial population (of chromosomes/ individuals). This population is typically by chance generate (randomly generated genes for each individual) and can be any required size, from only a few individuals to thousands individuals. The population consists of individuals, and these individuals consist of genes. Figure 1.5 shows that Initialization of gene here parent A and Parent B we just assume some binary digits for Initialization of gene.

Step 3: Crossover (Child generates) – at a few point in crossover we generate new persons by combining aspect of our selected persons. We can think of this as mimicking how femininity works in nature. The hope is that by combining certain behaviour from two or more individuals we will create an even 'fitter' offspring which will come into the best traits from each of its parents. Actually GA's are more well-organized than real world reproduction as we're already pre-selecting the top n individuals to mate, versus just having some desired human being friend with some less desirable chance one.

Step 4: Mutation: Each mutation using this method causes two genes mutated at the same time. First step of this method is determining two gene positions randomly. Then, genes in those positions are swapped. While in each mutation, two genes are swapped

Step 5: Selection Process (**fitness function**) – Fitness value is used to determine how good a chromosome is. Each member of the population is then evaluate and we calculate a 'fitness' (sometimes fitness can be a cost function, such as searching for minimum cost is the "best fitness") for that human being. The fitness value is calculated by how well it fits with our desired requirements. How you calculate the fitness of an individual is the most important part of the algorithm as it guides the evolutionary process to the best answer.

Step 6: Choosing Best Optimal Threshold Values: After the selection the next procedure is which value is the best value for producing the next generation.threshold value is adaptive which is choosing according to run time and value will be produced for the next generation

Step 7: Implementing OV's to current Image: We want to be constantly improving our populations in general fitness. Selection helps us to do this by discarding the bad

designs and only maintenance the best individuals in the population. There are a few dissimilar selection methods but the basic idea is the same, make it more probable that fitter individuals will be selected for our next generation and this implementation will be going away for whole images i.e. mask and will find the accuracy which wills the best one.

Morphological Noise reduction

Morphological image processing is a collected works of non-linear operations connected to the shape or morphology of features in an image, such as boundaries, skeletons, etc. In any given technique, we search an image with a small shape or pattern called a structuring element, which describe the region of interest or neighbourhood around a pixel. They are usually applied to binary images, although there are also gray level versions In this deed we outline the following basic morphological operations: 1. Erosion 2. Dilation

Erosion: Morphological erosion position a pixel to the *lowest amount over all pixels in the neighbourhood centred.* The structuring element agreed to erosion is a Boolean array that illustrates this neighbourhood. Below, we use disk to generate a circular structuring element. It exchanges whitish part to the blackish if there is majority of black.

Dilation: Morphological dilation sets a pixel at to the *maximum over all pixels in the neighbourhood centred.* Dilation expands bright regions and shrinks dark regions.

These two operators of Morphological Filtering works we can see in Figure 4.5 where noise which presents in image it's removed according to pixel requisite. This filtering mostly works on binary image, so this type of filtering is very supportive for detecting the Retinal Vessel from original image.

Results and Discussion

Materials

The methodology has been evaluated using two recognized publicly available databases (DRIVE and STARE) and a new public database (CHASE_DB1). The DRIVE database (5) contains 20 color images of the retina. The image set is separated into test and training sets and each one contains 20 images. The presentation of the vessel segmentation algorithms are calculated on the test set. The training of the classifier is performed on 20.

The CHASE_DB1 (7) is a new retinal vessel position dataset acquired from multiethnic school children. This database is a branch of the Child Heart and Health Study. For each of the three databases, there are two manual segmentations available made by two independent human observers for each of the images. This Data base images in put used as a ground truth. Operation has applied on 20 image of three data base. Apply the Genetic Algorithm Thresholding to notice the vessel then the result compare with Ground truth image, and find the values that is given in Table I.

Performance Measures

In the retinal progression, after comparing the ground truth image with the predicted image we will locate out parameter which is given in table II. And get the improved result. As a result, there are four events: two classifications and two misclassifications which are distinct in Table I. The accuracy (Acc) is calculated by the ratio of the total number of correctly classified pixels to the

number of pixels in the image FOV. Sensitivity (SN) reflects the capability of an algorithm to detect the vessel pixels. Specificity (SP) is the ability to spot non vessel pixels. The positive predictive value (PPV) or precision rate is the probability that an well-known vessel pixel is a true positive. These metrics are defined in Table II base on the terms in Table I.

The average of the selected measures of performance for the DRIVE, STARE, and CHASE_DB1 databases is tabulated in Table III. The average accuracy values and precision rates incurred by the algorithm are more than the second human observers for the DRIVE, STARE and CHASE databases. The specificity values for the algorithm are also upper than the second human spectator for each of the three image databases that indicate the low false positive rate of the methodology as compare with the second human observer. This, in revolve, indicates that the algorithm has acknowledged less numbers of background pixels or pathological area pixels as element of a vessel than the second human observer. The AUC values twisted by the method are more than 0.9790 for each of the retinal image sets. The segmented images with most excellent case and worst case accuracies from the DRIVE, STARE, and CHASE_DB1 databases are illustrated in below Figures. The best case accuracy, sensitivity, specificity, PPV and FDR for the DRIVE database are 0.9790, 0.9280, 0.9884, 0.8600, and 0.2540, respectively, and the worst case accuracy, sensitivity, specificity, PPV and FDR measures are 0.8319, 0.9561, 0.9447, 0.6556 and 0.1391 respectively. For the STARE database, the best case accuracy is 0.9998; sensitivity, specificity, PPV and FDR are 0.9880, 0.9995, 0.9982 and 0.5224 respectively. The worst case respectively, and the worst case accuracy, sensitivity, specificity, PPV and FDR process are accuracy is 0.8596, 0.9556, 0.9133, 0.4059, 0.0050 respectively. The best case vessel segmentation result for the CHASE_DB1 database has an accuracy of 0.9884, sensitivity, specificity, PPV and FDR 0.9295, 0.9899,0.8751 and 0.3071 respectively. The worst case accuracy is 0.9403; sensitivity, specificity, PPV and FDR are 0.7385,0.946, 0.5196 and 0.1674 correspondingly.

The specificity values for the algorithm are also superior than the second human observer for every one of the three image databases that indicate the low false positive rate of the method as compared with the second human viewer. This, in turn, indicate that the algorithm has identified less numbers of background pixels or pathological area pixels as part of a vessel than the second human observer. At the figure 5 shows that the evaluation of three data base. its very clear from figure 5 that first column is input images for different data base i.e drive stare and chase. second column is a proposed method which is compare with the Fraz method i.e shown in column third and we can see the results that proposed vessel is more clear than the second method which is Fraz method we get accuracy for Drive is 0.9790, for Stare is 0.9998 and for Chase is 0.9845 which is from the other method different is maximum, so we can say that the proposed method is much clear than the Fraz method.Retina images are obtained from the fundus camera and graded by skilled professionals. However there is significant deficiency of expert observers has confident computer assisted monitor. assessment of blood vessels network plays an important assignment in a variety of medical diagnosis. manifestation of frequent vascular disorder, such as diabetic retinopathy, depend on finding of the blood vessels network.

Table.1 Vessel classification

	Vessel Present	**Vessel Absent**
Vessel detected	True Positive (TP)	False Positive (FP)
Vessel not detected	False Negative (FN)	True Negative (TN)

Table.2 Performance measures for retinal vessel segmentation

Measure	**Description**
SN (Sensitivity)	TP/(TP+FN)
SP (Specificity)	TN/(TN+FP)
Acc (Accuracy)	(TP+TN)/(TP+FP+TN+FN)
PPV (Positive predictive value)	TP/(TP+FP)
FDR (Flight data recorder)	FP/(FP+TP)

Table.3 Performance measures on drive, stare, and chase_DB1

Data base	**Segmentation**	**Acc**	**SN**	**SP**	**PPV**	**FDR**
DRIVE	**2nd Human Observer**	**0.9480**	**0.7406**	**0.9807**	**0.8532**	**0.1467**
	Proposed Method	**0.9790**	**0.9280**	**0.9884**	**0.8600**	**0.3440**
STARE	**2nd Human Observer**	**0.9534**	**0.7548**	**0.9763**	**0.7956**	**0.2043**
	Proposed Method	**0.9998**	**0.9880**	**0.9995**	**0.9982**	**0.5224**
CHASE_DBI	**2nd Human Observer**	**0.9469**	**0.7224**	**0.9711**	**0.7415**	**0.2585**
	Proposed Method	**0.9845**	**0.9295**	**0.9899**	**0.8751**	**0.3071**

Table.4 Values of drive, stare, and chase_db1 according to graph values

Database	**ACC (1)**	**SN (2)**	**SP (3)**	**PPV (4)**	**FDR (5)**
DRIVE	**0.9790**	**0.9280**	**0.9884**	**0.8600**	**0.3440**
STARE	**0.9998**	**0.9880**	**0.9995**	**0.9982**	**0.5224**
CHASE	**0.9845**	**0.9295**	**0.9899**	**0.8751**	**0.3071**

Figure.1 Retinal fundus image

Fig.2 Extraction of RGB image

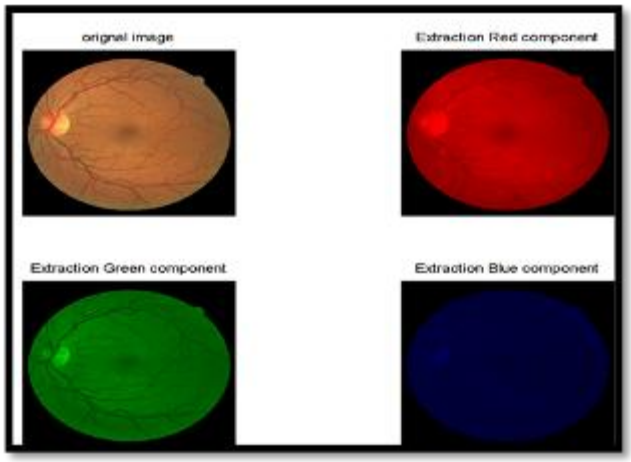


Figure.3 Initializations of genes

Parent

1	1	0	1	0	1

Parent B

1	0	0	1	0	0

Figure.4 Crossover of binary (0/1) genes

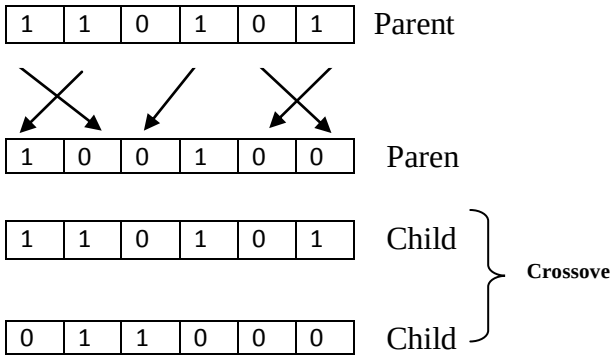


Figure 5 Mutation changes make a tiny (random) gene change

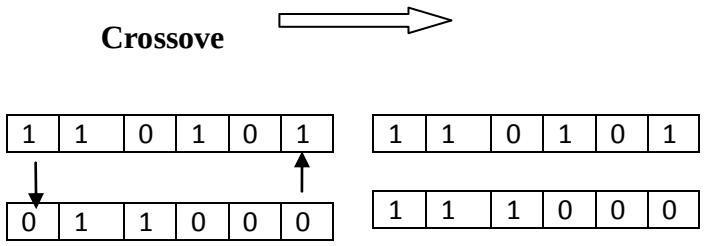


Figure.6 Morphological Noise Reductions

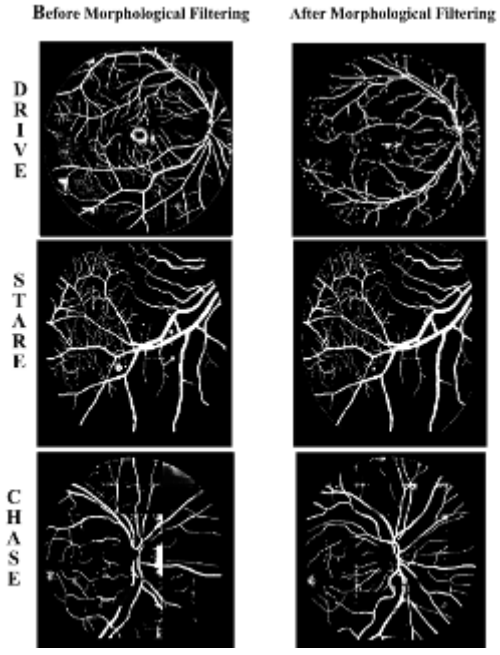


Figure.7 For Drive data base best and worst case For drive

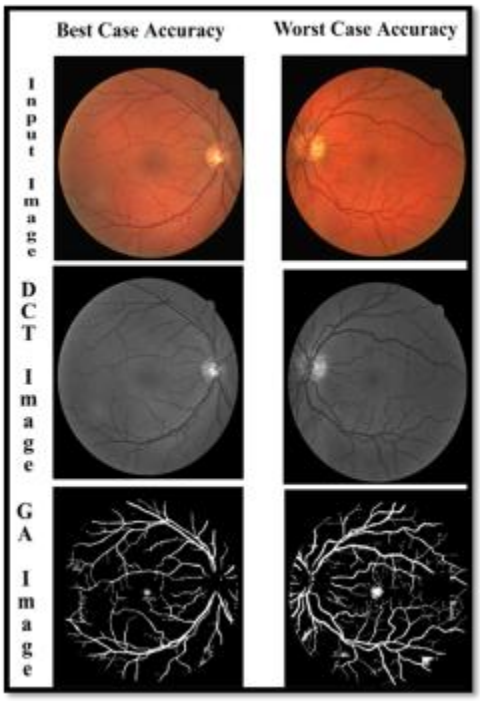


Figure.8 For stare data base best and worst case

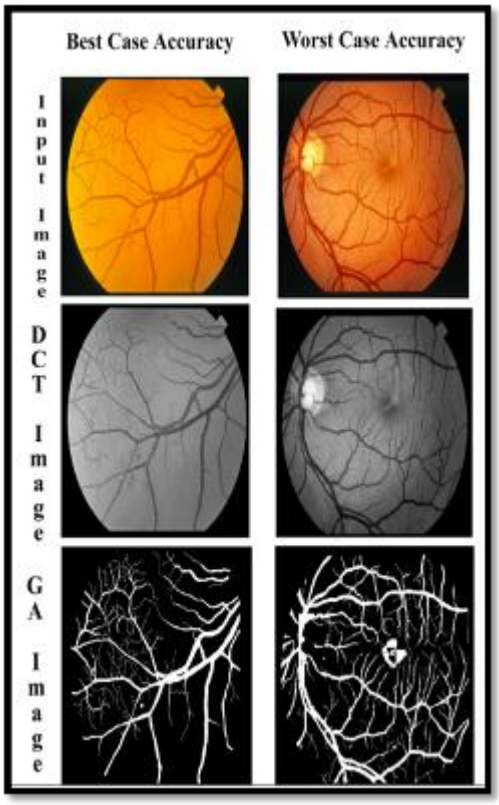


Figure.9 For Chase data base best and worst case

Figure.10 Comparison of segmentation image for Drive, Stare and Chase

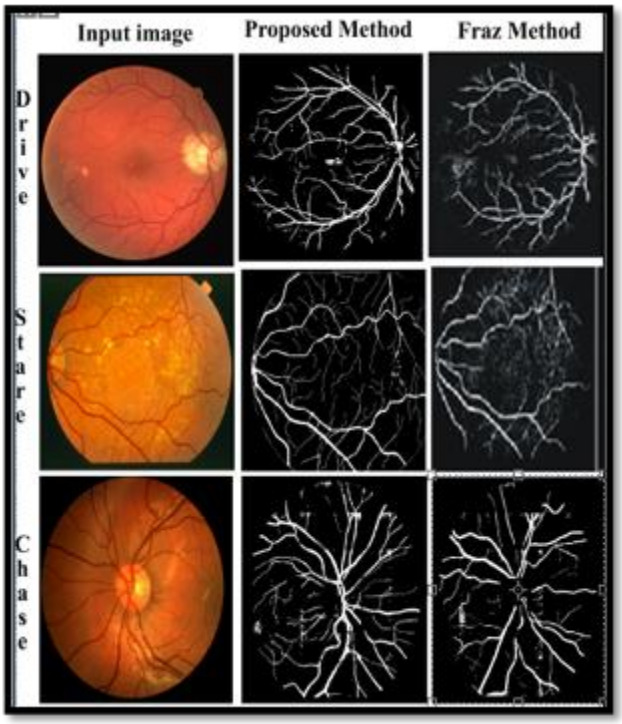


Figure.11 Comparison of Vessels

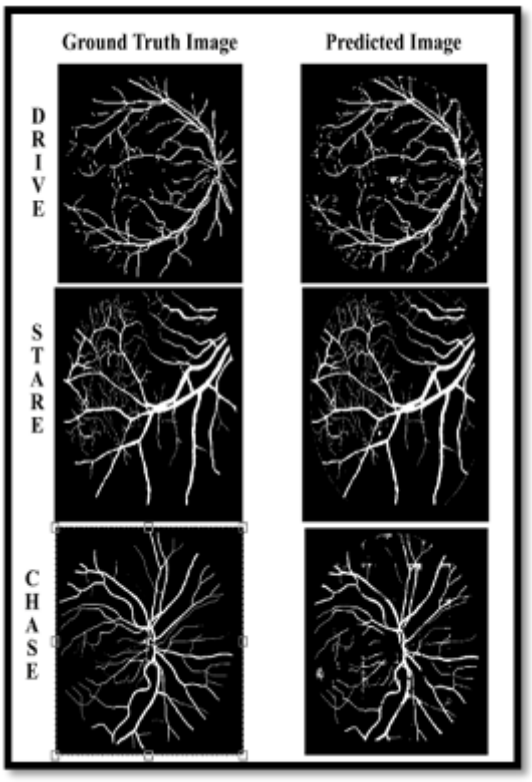


Figure.12 Comparison of segmentation image by using graph plotting for Drive, Stare and Chase

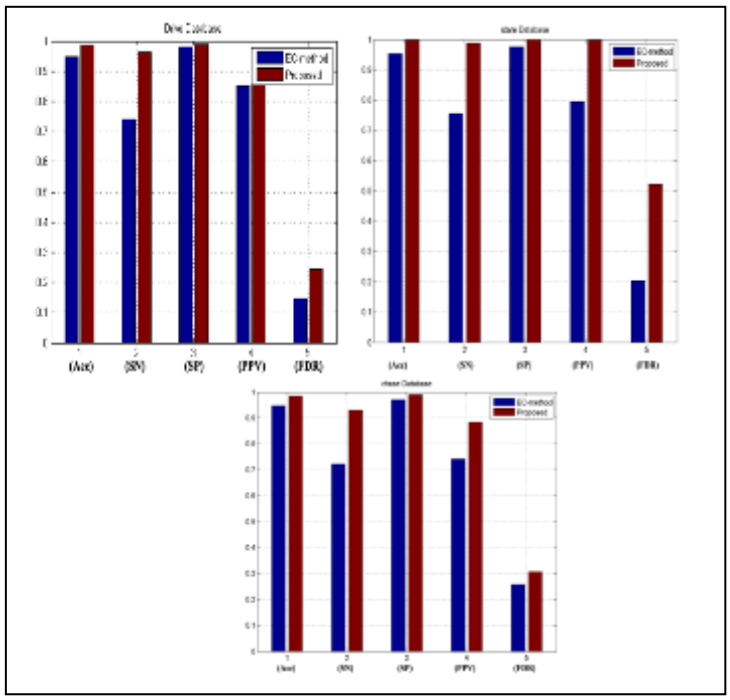
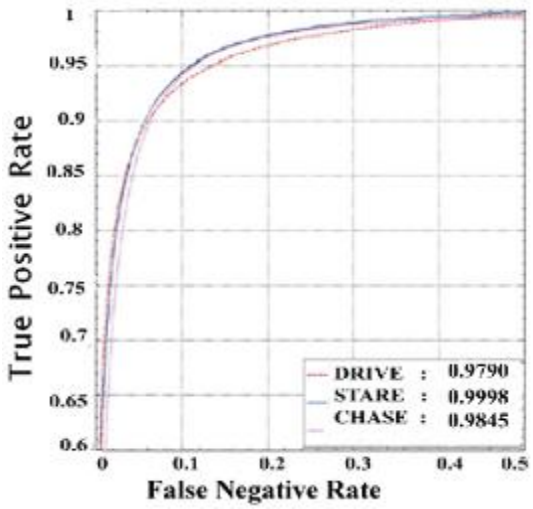


Figure.13 ROC Plot for proposed method



In this work the fundus RGB image is used for obtain the traces of blood vessels and areas of blood vessels are used for discovery of Diabetic Retinopathy (DR). The algorithm developed uses morphological operation to extract blood vessels. Mainly two steps are used: firstly operation is applied to original retina image to remove noise and increase contrast of retinal blood vessels. Secondly morphology operations are used to take out blood vessels. Experiments are conducted on publicly available DRIVE, STARE and CHASE database. Which is clear in figure 6 and that result compared with ground truth vessels.

ROC Plot : relative analysis shows that the proposed method realize better performance metrics than most of the previous methods. The area under ROC and the true positive rate attain by the algorithm appear better than all the published methods for the DRIVE,STARE and CHASE databases

Conclusion

In this examine we think about a Retinal image which has been occupied from the Drive and starve database initially we remove the background noise by applying the Pre Filtering technique and then extract the RGB component and we work on the green component then concern DCT Filtering on the green component. DCT filtering be of assistance to take away the noise from image and the lighting effect from the Digital images. Its means it resolve work like LPF(Low Pass Filter) where elevated frequency will be rejected and only low down frequency will be passed. next to final we concern Genetic Algorithm for the development of vessel detection of Retinal images we apply the Genetic Algorithm on the 20 sample image which each and every one are from the database Drive, Stare, Chase_dbi and conduct more accuracy 0.9790 which has a variation of 3.27 for drive to 1st Human observer and sensitivity, specificity, PPV and FDR for the DRIVE database are 0.9280, 0.9884, 0.8600, and 0.3440, correspondingly For the STARE database, accuracy is 0.9998 which has a variation of 4.78 for stare to 1st Human observer sensitivity, specificity, PPV and FDR are 0.9880, 0.9995, 0.9982 and 0.5224 respectively. The greatest case vessel segmentation result for the CHASE_DB1 database has an accuracy of 0.9845 which

has a variation of 3.97for chase to 1st Human observer sensitivity, specificity, and PPV are 0.9295, 0.9899, 0.8751, and 0.3071, respectively. Consequently, in this way we become aware of more vessels and improve result than the Fraz Method.For prospect work we will improve vessel detection through which we detect more vessel and Genetic Algorithm motivation be alive improved by using particle swam optimization

References

1) D. Usher, M. Dumskyj *et al.* "Automated detection of diabetic etinopathy in retinal images: a tool for diabetic retinopathy screening," *Diabet Med*, vol. 21, pp. 84–90, 2004.
2) Andrew Hunter, James A. Lowell, Bob Ryder, Ansu Basu, David Steel" Automated Diagnosis of Referable Maculopathy in DiabeticRetinopathy Screening" September, 2011
3) G.E. Lang, "Diabetic retinopathy", Development in Ophthalmology, 2007.
4) Romany Fouad Mansour. "Using Genetic Algorithm for Identification of Diabetic Retinal Exudates in Digital Color Images" pp.188-198,2012
5) Herbert F. Jelinek, Anderson Rocha, Tiago Carvalho, Siome Goldenstein,Jacques Wainer," Machine Learning and Pattern Classification in Identification of Indigenous Retinal Pathology."2011
6) A. D. Hoover, V. Kouznetsova, and M. Goldbaum, "Locating blood vessels in retinal images by piecewise threshold probing of a matched filter response," *IEEE Trans. Med. Imaging*, vol. 19, no. 3, pp. 203–210, Mar. 2000.
7) R.Venkata,Ramana Chary, Dr.D.Rajya Lakshmi and Dr. K.V.N Sunitha" FFeature Extraction Methods for Color image similarity" Advanced Computing: An International Journal ACIJ), Vol.3, No.2, March 2012
8) M. Ikram, J. Witteman, J. Vingerling, M. Breteler, A. Hofman and P. de Jong, "Retinal Vessel Diameters and Risk of Hypertension: The Rotterdam Study," *Hyperten-sion*, Vol. 47, 2006, pp. 189-194.
9) R. Klein, B. Klein, S. Moss, T. Wong, L. Hubbard, K. Cruickshanks and M. Palta, "The Relation of Retinal Vessel Caliber to the Incidence and Progression of Dia-betic Retinopathy—Xix: The Wisconsin Epidemiologic Study of Diabetic Retinopathy," *Archives Ophthalmology*, Vol. 122, No. 1, 2004, pp. 76-83.
10) H. Li and O. Chutatape, "A model-based approach for automated feature extraction in fundus images," in Proc. 9th. Int. Con! Of the IEEE Compo Vision, ICCV' 03, Nice, France, pp. 50-53, 2003.
11)R.Datta, D.Joshi, J.Li, J.Z.Wang. "Image Retrieval: ideas, Influences, and Trends of the New Age". ACM Transactions on Computing Surveys, Vol. 40, No22008)
12) Najlae Idrissi. "Bridging the Semantic Gap for Texture based Image Retrieval and Navigation, Journal Of Multimedia", Vol.4, No.5, October 2009
13) M. L. Kherfi, D. Ziou, and A. Benard. "Image retrieval from the World Wide Web: Issues, techniques and systems". ACM Computing Surveys, 361):35{67, 2004}
14)Aliaa Abdel-Haleim Abdel-Razik Youssif, Atef Zaki Ghalwash, and Amr Ahmed Sabry Abdel- Rahman Ghoneim: Optic disc OD) detection for developing automated screening

systems for diabetic retinopathy. 2008

15) Xu, L and S.Luo: A novel method for blood vessel detection from retinal images. Biomed.Eng.,9:14-14.DOI:10.1186/1475-925x-9-14, 2010.

16)Oliver Faust, Rajendra Acharya U.E.Y.K.Ng.kwan-Hoong Ng. Jasjit S. Suri: Algorithms for the automated detection of diabetic retinopathy using Digital Fundus images. A review," Springer science and business media LLC, Journal of medical system., 2010.

17)Oliver Faust, Rajendra Acharya U.E.Y.K.Ng.kwan-Hoong Ng. Jasjit S. Suri: "Algorithms for the automated detection of diabetic retinopathy using Digital Fundus images" 2010.

18) Praveen Ranjan,Srivastava1 and Tai-hoon Kim"Application of Genetic Algorithm in Software Testing" Vol. 3, No.4, October 2009.

19) Keerthi Ram "Detection of diabetic retinopathy lesions in color retinal images" Hyderabad, India, December 2009.

20) Osareh and Shadgar "Automatic Blood Vessel Segmentation in Colour Image Of Retina Vol. 33, Iran, 2009.

21) Yong Yang, Shuying Huang and Nini Rao "An Automatic Hybrid Method For Retinal Blood Vessel Extraction"Vol. 18, No. 3, 2008.

22) Jian Chena, Jie Tiana,b,, Zichun Tanga, Jian Xuea, Yakang Daia and Jian Zhenga "Retinal vessel enhancement and extraction based on directional field" June 2008.

23) Manal Bouhaimed, Robbie Gibbins and David Owens "Automated Detection of Diabetic Retinopathy: Results of a Screening Study" Volume 10, No 2, 2008.

24)Aliaa Abdel-Haleim Abdel-Razik Youssif, Atef Zaki Ghalwash, and Amr Ahmed Sabry Abdel- Rahman Ghoneim: "Optic disc OD) detection for developing automated screening systems for diabetic retinopathy" 2008.

25)Manal Bouhaimed and David Owens "Detection of Diabetic Retinopathy"Results of a Screening Study" Volume 10, Number 2, 2008

26)Rus¸en O ktem,Karen Egiazarian, Vladimir V. Lukin, Nikolay N. Ponomarenko,and Oleg V. Tsymbal"Locally Adaptive DCT Filtering for Signal-Dependent Noise Removal" EURASIP Journal on Advances in Signal Processing Volume 2007.

27) Saeid Fazli and Sevin Samadi "A Novel Retinal Vessel Segmentation Based On Histogram Transformation Using 2-D Morlet Wavelet and Supervised Classification" 2007

28) A.M Aibinu, M.I Iqbal2, M. Nilsson and M.J.E Salami "Automatic Diagnosis of Diabetic Retinopathy from Fundus Images Using Digital Signal and Image Processing Techniques" 2007.

29)Al-Rawi M, Karajeh H: "Genetic algorithm matched filter optimization for automated detection of blood vessels from digital retinal images. Computer Methods Programs Boomed"., 2007.

30) Enrico Grisam, Marco Foracchia and Alfred Ruggeri, "A novel method for automatic grading of retinal vessel tortuosity," IEEE Transactions on Medical image,2007.

31) V. B. Soares, J. G. Leandro,M. Cesar-Jr., F. Jelinek, and Michael J. Cree "Retinal Vessel Segmentation Using

the 2-D Morlet Wavelet and Supervised Classification" May 2006.

32)Lassada Sukkaew, Bunyarit Uyyanonvara, Sarah A Barman, and Jaruwat Jareanjit "Automated Vessels Detection on Infant Retinal Images" Bangkok, 2004.

33)Joes Staal, Michael, Meindert Niemeijer, Max A. and Bram "Ridge-Based Vessel Segmentation in Color Images of the Retina" Vol. 23, No. 4, 2004.

34) Xiayu Xu, Meindert Niemeijer, Qi Song, Milan Sonka, Mona K. Garvin, Joseph M. Reinhard and Michael D. Abràmoff "Vessel Boundary Delineation on Fundus Images Using Graph-Based Approach" 2011 IEEE

35)Hasan Mir,Hasan Al-Nashash, U. R. Acharya "Assessment of Retinopathy Severity Using Digital Fundus" 2011 IEEE

36)Zafer Yavuz, Cemal Köse "Retinal Blood Vessel Segmentation Using Gabor Filter And Tophat Transform" 2011 IEEE.

37)Danu Onkaew, Rashmi Turior, Nishihara Akinori, Chanjira Sinthanayothin "Automatic Retinal Vessel Tortuosity Measurement using Curvature of Improved Chain Code" 2011 IEEE.

38)Maryam Mubbashar, Anam Usman, M. Usman Akram "Automated System for Macula Detection in Digital Retinal Images" 2011.

39)Diego Fiorin and Alfredo Ruggeri "Computerized Analysis of Narrow-field ROP Images for the Assessment of Vessel Caliber and Tortuosity" 2011 IEEE

40)Herbert F. Jelinek, Anderson Rocha, Tiago Carvalho, Siome Goldenstein, Jacques Wainer "Machine Learning and Pattern Classification in Identification of Indigenous Retinal Pathology" 2011 IEEE.