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Detection of Diabetic Retina Using Morphological Technique

M. Rajalakshmi[1], Anita Rose J T [2], Sangeetha Francelin Vinnarasi F[3]

PG Student, Dept. of CSE, St.Joseph's College of Engineering, Chennai, Tamilnadu, India[1]

Associate Professor, Dept. of CSE, St.Joseph's College of Engineering, Chennai, Tamilnadu, India[2]

Associate Professor, Dept. of CSE, St.Joseph's College of Engineering, Chennai, Tamilnadu, India[3]

ABSTRACT: Diabetic retinopathy(DR) which serves as main cause of blindness among diabetic patient is mainly due to the lekage of protein and blood into the retina from small diseased vessels. Detection of diabetes in the early stage at the retinal vessels is very much useful for prevention of disease. Therefore, extraction of blood vessels accurately from the images is easy for diagnosis of such eye diseases. In this paper a approach to detect the blood vessels from the digital retinal images is being proposed. The morphological technique is useful in enhancement of blood vessels and elimination of background with noise removal. Post-processing is for removal of unwanted regions and to fill the gaps within detected vessel. Due to high detection rate the proposed method is good in detecting the diabetic disease in retina comparable to other techniques as shown by the experimental results.

KEYWORDS: Retina, vessel segmentation, retinopathy, classification.

I. INTRODUCTION

Diabetic retinopathy (DR) is one of the main cause for visual impairment among the adults aged 20-74 years[1]. The common indications are dilated retinal, veins, hemorrhages, hard exudates and cotton wool spots[2]. An investigation of retinal vessel features help in recognizing the progressions and premit the patient to take measures during the initial stage itself.

Segmentation of the retinal blood vessel characteristics like normal or abnormal branching, color, diameter, optic disk morphology is helpful for the eye experts and the opthalmologists to perform treatments. As manual segmentation procedures takes hours for assessment for just a single eye to overcome this the automated framework extracting the vessel structures in retinal images was found to decrease the workload of eye clinicians.

Diabetic retinopathy cant be detected early as it has no initial signs. Macular edema, which is one of the vision loss also has no warrning signs. A person if has blurred vision, unable to read or drive is having macular edema. The first stage is called non-proliferative diabetic retinopathy(NPDR) in which there are no symptoms and can be detected only through fundus photography inorder to find out the microaneurysms which are the microscopic blood-filled bulges in the artery walls can be seen.

In the second stage called the proliferative diabetic retinopathy (PDR), in this new abnormal blood vessels which are fragile and can brust which leads to bleeding of blood and will blur the vision are formed at the back of the eye. The type I and type II diabetic patients are at risk. After two decades of diabetes, almost all patients of type I and more than 60% of type II patients have some symptoms of diabetic retinopathy. During the time of pregnancy, the women with diabetes can also suffer from the problem of diabetic retinopathy. People with a chromosome 21 material almost will never have diabetic retinopathy.

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Diabetic retinopathy is being detected in an eye examination that has the following: Visual acuity test, This is the method in which a chart called the eye chart is been used to measure how a persona can see things at various distance. Pupil dilation, In this the eye care professional uses a eye drop to dilate the pupil of the eye, this is used to see the retina for diabetic retinopathy signs. Ophalmoscopy,In which eye professional looks through a slit lamp with a special magnifying lens that gives the view of retina. Optical coherence tomography (OCT), This is used for measuring the thickness of the eye and observe the swelling.

The early signs of the disease are: blood vessel leakage, swelling of the retina, deposits on the eye, nerve tissue damage, blood vessel changes.Various vessel segmentation methodologies are been used but still need improvements. The existing system should be enhanced in terms of the following drawbacks.

Firstly,due to varying image conditions the image generated is of poor quality as a result of under and over segmentations. Secondly, the postprocessing and preprocessing operations are used for extracting retinal vessels is of high computational cost. Thirdly, inorder to choose the area of interest, human participation is a must and this shows that the system is not totally automatic.

Diabetic retinopathy which causes vision loss has three major treatments like laser surgery, injection of corticosteroids. These treatments can only prevent diabetic retinopathy but it cannot cure the diseases. In laser photocoagulation there are two scenarios for the retinopathy treatment which is used for creating a grid which is of 'C' shaped area around macula treated with low intensity small burns and helps in clearing the macular edema. This grid is created at the posterior pole inorder to treat the macular edema and is used for controlling the panretinal coagulation towards the control of neovascularization. This method is mostly to be used during the stage of proliferative retinopathy.

In the treatment of diabetic retinopathy in the advanced level use the burns inorder to destroy the abnormal vessels that are present in the retina which in turn reduces the risk by 50%. Laser surgery will reduce the colour and night vision. After this treatment the patient is recommended to wear an eyepatch for few weeks to protect the eye and also prescribed drops to protect against infection.

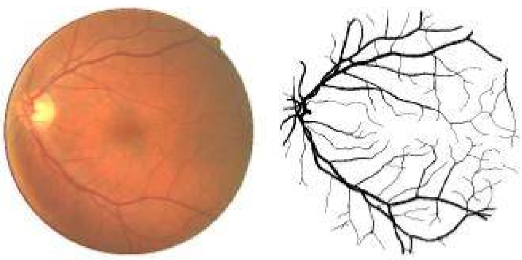

Fig 1 Normal eye

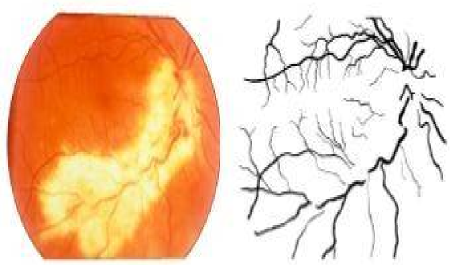

Fig 2 Diabetic eye

II. RELATED WORK

A number of algorithms and methodologies has been reported for retinal vessel segmentation[3]. They are classified based on pettern recognition, morphological processing, match filtering, vessel tracking, model-based and multiscale analysis. Futhur classification of the pattern recognition is as follows: supervised and unsupervised methods.

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The methods like principal component analysis[5], k-nearest neighbor classifiers[4], support vector machine(SVM) classifier[6] comes under supervised methods. The methods like fuzzy C-means clustering algorithm[7], maximum likelyhood estimation of vessel parameter[8], radius-based clustering algorithm[9] comes under unsupervised methods.

Archana sharma and hemapriya detected the blood vessels and diseases in human retinal images. The major task in diagnosing the eye is by detection of blood vessels. Here an automated system was developed to extracte the normal and abnormal features from the retina. The network of the blood vessel is the important structure of the human eye. The performance in automatic detection can be excluded from the analysis for several diseases as diabetic retinopathy[10].

Akansha Mehrotra detected the blood vessels from the fundus image by automated blood vessels detection. This method does all the initial operations such as image preprocessing and then the blood vessels are applied with some morphological operations such as top-hat and bottom-hat transformation. At last to cluster the given input image Kohonen Clustering Network is being applied[11].

Siva Sundhara Raja diagnosed, detected and analyzed the diabetic retinopathy by a method called the retinal image diagnosis. In his work he made use of the SVM classifier to detect and segment the blood vessels from the image. He did this process in three stages such as preprocessing the retinal image, enhancement of the image and segmenting the vessels. The system is then analyzed using the available dataset[12].

RR Radha used a method in which the retinal images where detected efficiently using the exudates and the retina is found whether it is normal or abnormal. Then the morphological operations were applied to find the ridges in the retinal image[13]. K.Jeyasri method was to detect the retinal images and diagnose the disease as the retinal image plays a vital role in several applications such as human eye recognation[14].

Mendonca and campilho used vessel centerliness and filtering process in the form of vessel segmentation algorithm. The enhancement technique called multiscale morphological was used in contrasting the blood vessels. Palomera-Perez et al for segmenting the blood vessels used feature extraction based region growing algorithm. And furthur to group the vessels domain partitioning based parallelism was used.

Xiao et al made use of the Bayesian classfier inorder of segmenting blood vessels based on spatial constraint. To seperate the background pixels from the vessels an energy function was used. Manoj et al used the neural network classifier in feed forward blood vessel segmentation.

Bansal and Dutta, for segmentation of vessels used fuzzy algorithm. The fuzzy rules were contructed to differentiate the vessels from the non-vessels. Marin et al used supervised classifier for segmentation and gray level feature extraction. To improve the background homogenization the contrast of blood vessels were applied. It takes just one minute and thirty seconds to process a single image.

Budai et al for segmentation used Frangi algorithm of extended version. In this the vessel computational time was 1.31 seconds. Soares et al used SVM classifier and 2D-Gabor wavelet transform in retinal images. In this the computational time is 180 seconds.

III. PROPOSED SYSTEM

The proposed system includes stages as shown in fig 3. The input retinal color image is take and using GLCM matrix the image is converted into gray image. The image is then extracted for green plan then this image is trained to extract the features. This image is then segmented for analysis whether its normal or abnormal.

A) Preprocessing
In this the image of the back eye called the retina is being collected. Then this image is one by one trained. First the color image will be converted into grayscale image using the GLCM matrix.

B) Plane seperation
The moderate intensity is the green plane and it is extracted from the other two red plane and the blue plane. This green plane is then used for the next process.

C) Feature extraction
The features such as energy, colour, entropy, texture are extracted. These features from the high-low and low- high band are calculated for all the images. These values are then converted into binary format.

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D) Segmentation

The image is segmented inorder to find out the affected region based on the region it is found whether the paitient is affected by diabetic retinopathy or not.

- The RGB color image is taken from the paitent and stored in the database.
- Then this image along with the other images are being trained and kept in the database.
- The collected image of the paitent's retina is extractes for green plane.
- This image is then converted into grayscale image.
- The features are extracted using GLCM matrix. The images from the database are also trained by extracting their features.
- Then their binary value is calculated for futhur comparison.
- These images are then segmented using automatic blood vessel segmentation inorder to fing out the affected part.
- Finally, the image is classified based on its features as normal or abnormal.
- If the image is normal it means the paitent has no diabetic retinopathy and is the image is abnormal then it means the paitient is affected by diabetic retinopathy.

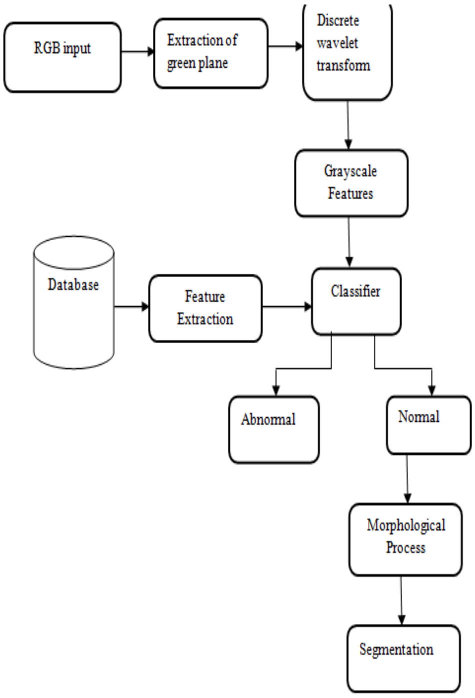

Fig 3 Architecture flow

Researchers have employed many practices for energy disaggregation. Early authors proposed supervised approaches which had a disadvantage of labeling and training overhead. Then unsupervised approaches came forth which still suffered training expense because it unlabeled data for training. Recently, researchers have overcome this overhead by employing training less approach.

Optimization based Supervised Methods

Optimization based methods compares the captured feature an unknown appliance to the present pool of the load database. Researchers [28, 3] proposed different optimization techniques using genetic algorithms and integer programming. But there exists a challenge due to its increased complexity of comparison in the presence of unknown appliances and appliances with overlapping power feature.

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Pattern Matching Based Supervised Methods

Pattern matching is the most simple and most frequently employed approach for energy disaggregation. Pattern matching algorithm could be traces in early works of Hart [5] in which loads form their distinct clusters in the active and reactive power plane. For load identification, the steady-state events are mapped to an appliance feature space. And then, clustering analysis is performed to verify if the new feature already exists along known clusters. Though this method appears it cannot identify appliances with overlapping power and real time features.

Researchers [7, 30- 32] have tried to improve the disaggregation performance through smoothing and filtering aggregated power before recognition of appliances, but is highly complex due to excessive training. Another author [1] made use of the Bayesian method where power was used to identify the likely state of an appliance. Bayesian classifier is assigned to each individual appliance and trained accordingly.

However this approach fails for appliances whose operation are correlated. Authors have used temporal information along with real power values for performing load disaggregation [2, 33]. Researchers have also used techniques namely Hidden Markov Models (HMM) Artificial Neural Networks (ANN) [34] for load disaggregation. Construction of HMM models for large number of appliances is quite exhaustive and complex. For each new appliance added HMM models have to be retrained which is also a challenge

Alternatively, ANN [11] works well for large number of appliances. However it needs exhaustive training for each load. On the other hand, Support Vector Machines (SVM) using low frequency features and harmonic signatures has shown good performance in disaggregating appliances [17, 36, and 33]. Liang et al. [3, 37] have used committee decision mechanisms (CDM) to perform disaggregation aimed to increase its accuracy.

VI. CONCLUSION

The retinal vessel segmentation has been done inorder to revel accurate results in the system to be saved in the database. The retinal condition after the exact detection to know whether it is normal or abnormal has been done successfully. In case of abnormal retina the detection was accurate by extracting the exudates by using k-means clustering. The extracted features are thus trained by Probabilistic Neural Network. When the edges were detected using the structuring elements morphology, the false edges were removed by morphological opening method at the same time preserving the thin vessel edges correctly. Hence, our future work is to find a proper approach inorder of increasing the accuracy of finding the retinopathy in the early stage.

V. EXPERIMENTAL RESULTS

The retina color image is taken for preprocessing as shown in fig 4. This images are captured using highly specialized camera.

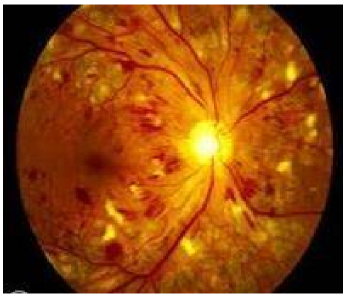

Fig 4 Input image

The gray image is obtained by using GLCM matrix as shown in fig 5. This image is then futhur taken for other processing.

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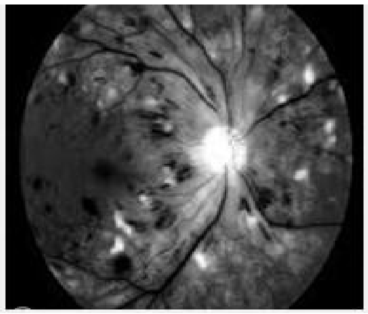

The discrete wavelet transform is applied inorder to extract the features as shown in fig 6 like texture,color,energy,entropy. saved.

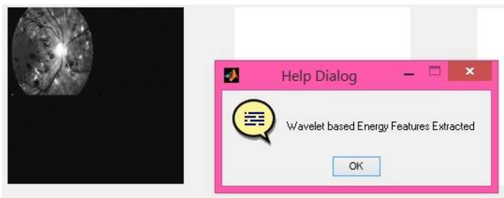

Fig 6 Feature extracted

The other images in the database are trained as shown in fig 7 as well. The features are extracted and are

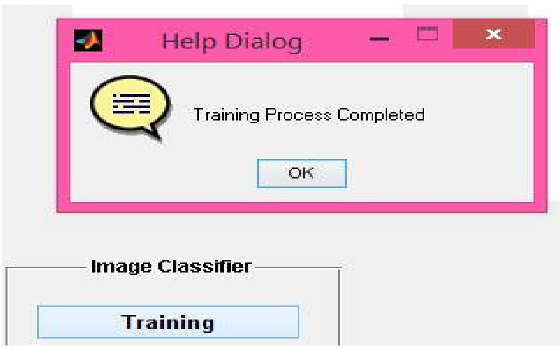

Fig 7 Training

The morphological process is applied and the image is being dilated as shown in fig 8.

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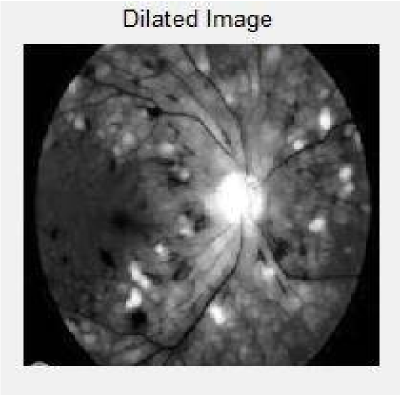

Fig 8 Dilation

The image is applied with erosion as shown in fig 9. Then the image is segmented.

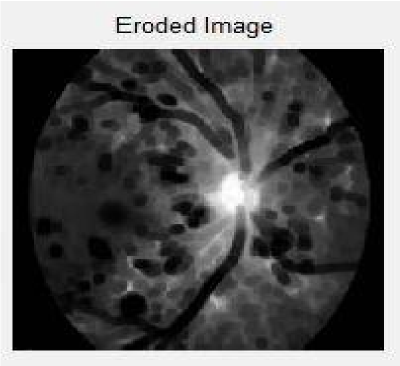

Fig 9 Erosion

The segmented image is a sample of abnormal image as shown in fig 9. Thus the image is proved as abnormal so, the paitent is affected with diabetic retinopathy.

Fig 9 Abnormal image

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