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EARLY DETECTION OF GLAUCOMA USING EMPIRICAL WAVELET TRANSFORM

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ABSTRACT- *Glaucoma is second leading ocular disease and early detection of Glaucoma can prevent progression progression of disease and consequently loss of vision. Unfortunately, Glaucoma symptoms are painless the brain compensates gradual vision impairment to considerable extent. Here we presents new methodology for an automated diagnosis of glaucoma using digital Fundus image based on Empirical Wavelet Transform(EWT).EWT is used to decompose image and structural features are extracted from decomposed EWT components. These extracted features are ranked based on t value feature selection algorithm. These features are used for classification of normal and glaucoma image using Least Square Support Vector Machine Classifier.*

Keyword-Glaucoma, Empirical wavelet Transform, Feature selection, Least Support Vector Machine, Structural features

1. INTRODUCTION

Glaucoma is one of the leading causes of vision loss. This disease caused due to increased fluid pressure and improper drainage of fluid in the Eye. It is estimated that in 2013 worldwide 64.3 million aged 40 to80 years suffered from Glaucoma. This figure expected to reach 76 million by 2020 and 111.8 million by 2040.The prevalence of Glaucoma is 2.5% of all ages and 4.8% for above 75 years. Diagnosis of glaucoma mainly depend on Intra Ocular Pressure (IOP), medical history of patient's family, change in optic disc Structure. Glaucoma suspect have IOP more than 21mmHg.Monitoring Method of Glaucoma are Optical Nerve Hyperplasia Stereo Photographs (ONHSPs), advanced imaging technology such as Optical Coherence Tomography (OCT), Scanning Laser Polarimetry (SLP), Co focal Scanning Laser Opthamlomology (CSLO) to generate reference image to study eye and its internal structure. These Method are expensive and required skilled supervision. Combining various Method will improve accuracy of Glaucoma identification.

Glaucoma is a chronic eye disease that leads to vision loss Glaucoma is caused due to the increase in intraocular pressure of the eye. The intraocular pressure increases due to malfunction or malformation of the drainage system of the eye. The anterior chamber of the eye is the small space in the front portion of the eye. A clear liquid flow in and out of the chamber and this fluid is called aqueous humor. The increased intraocular pressure within the eye damages the optic nerve through which retina sends light to the brain where they are recognized as images and makes vision possible Glaucoma is a condition that causes damage to your eye's optic nerve and gets worse over time. It's often associated with a build-up of pressure inside the eye. Glaucoma tends to be inherited and may not show up until later in life. The increased pressure, called intraocular pressure, can damage the optic nerve, which transmits images to the brain. If damage to the optic nerve. Glaucoma Disease is characterized by change in structure of nerve fiber and optic disc parameter such as diameter, area, volume. Structural Changes occur due to obstruction to discharge of Aqueous humor, which in turn increases IOP.this injures optic nerve fiber and prevent transmission of information from eye to brain.

Fundus image are used for diagnosis of glaucoma disease. Damage to optic nerve fiber is detected using Structural Feature of Fundus Image. Structural Feature such as Change in Retinal Layer, Optic Disk(OD),Optic Cup(OC),Vertical Cup To Disc Ratio, Horizontal Cup To Disc Ratio, Neuroretuinal Rim Thicknesses, RNFL Thickness are used to diagnosis of Glaucoma.EWT is used for automatic diagnosis of Glaucoma Detection. The Principal Working of EWT based on Frequency Spectrum of signal.EWT decomposes image into different frequency band. Structural Feature is extracted from decomposed EWT component. These Features are ranked and normalized on the basis of t value feature selection algorithm.

2. SYSTEM MODEL

To fulfill objective i.e. to design method for automatic diagnosis of Glaucoma disease using EWT. System model of proposed methodology shown in **fig 1:**

2.1. Image AcquisitionThe first step in fundal digital image analysis is image capture. We have used publically available database .This Database consist of 89 images.

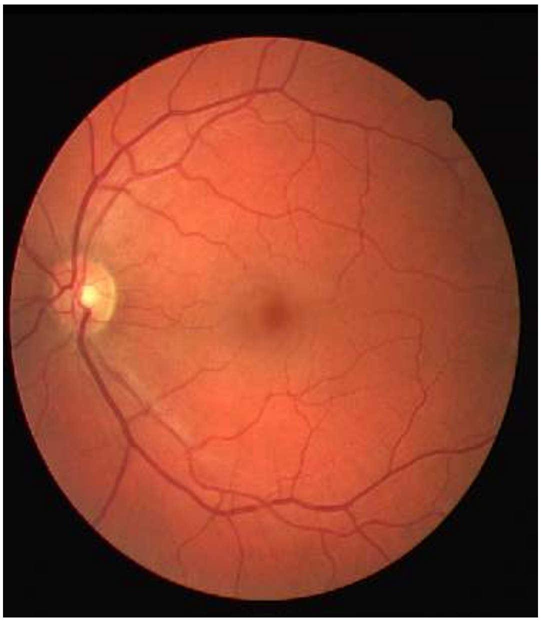

Fig 2.Original Image

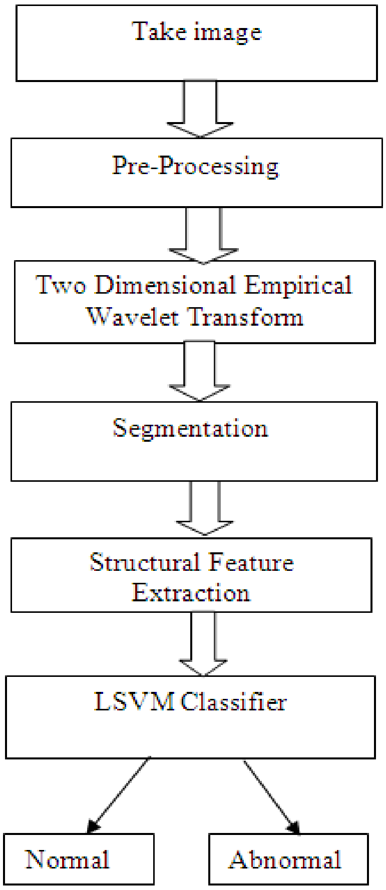

Fig 1.Architecture of Proposed Method

2.2.Pre-processing**:**

A. Image Resizing

Image Resizing is necessary when you want to increase or decrease total number of pixels. All the image in database are not in fixed size we have to do image resizing.

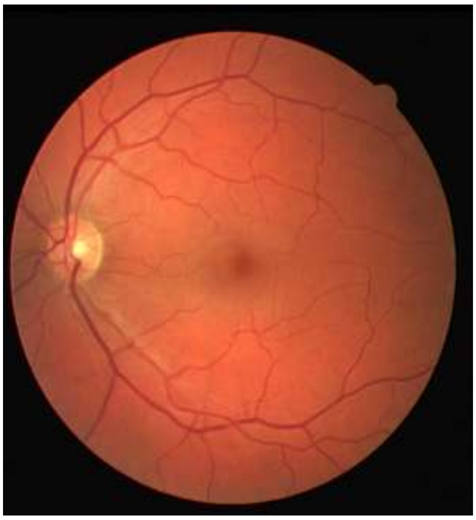

Fig 3.Resize Image

B. Image Enhancement

Image Enhancement is the process of adjusting digital images so that results are more suitable for display or further image analysis. Histogram Equalisation technique is used for adjusting image intensities to enhance contrast.

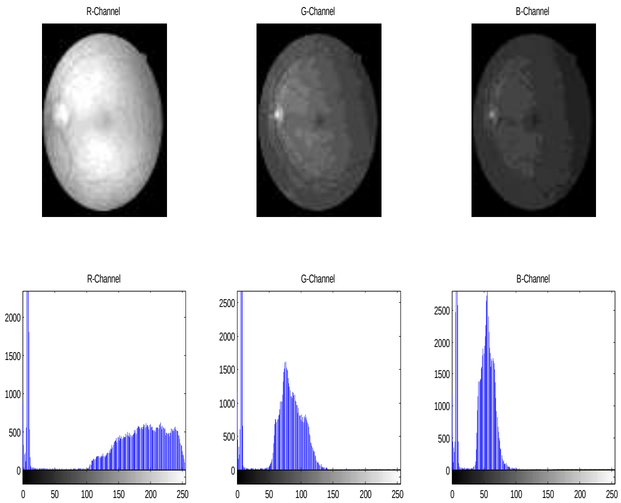

Fig 4.Enhanced Image

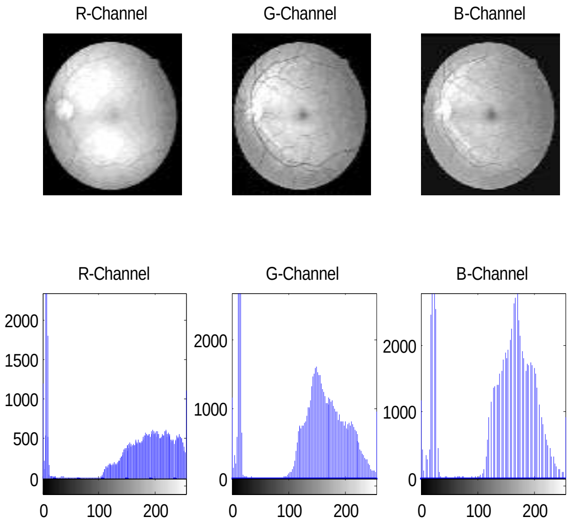

Fig 5.Enhance image using R, G, B image

B. Median filter

Median filter is a nonlinear digital filter used to remove noise from an image. Median filter smoothes the image and thus it is useful in reducing noise.

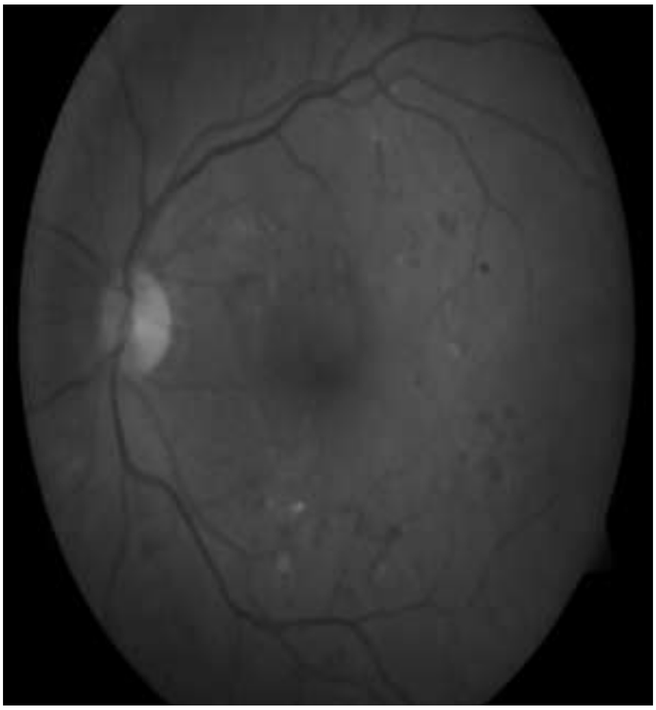

Fig 6.Median Filtered Image

2.3. Empirical Wavelet Transform

The Empirical Wavelet transform aims to decompose a signal or an image on wavelet tight frames which are built adaptively. The advantage of empirical approach is to keep together some information that otherwise would be spilt in case of dyadic filter.

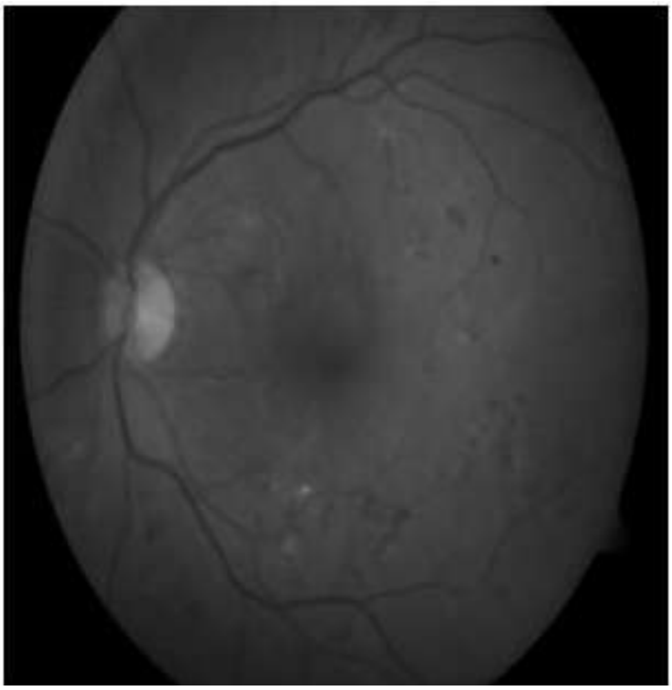

Fig 7.Decomposed Image

2.5. Image Segmentation

The optic disk is extracted by finding the reason of interest based on colour. In order to calculate region of interest in the original image, mathematical morphology like dilation, erosion is done to smoothen the image. After performing morphological operation small holes get filled and object boundary get smoothen.

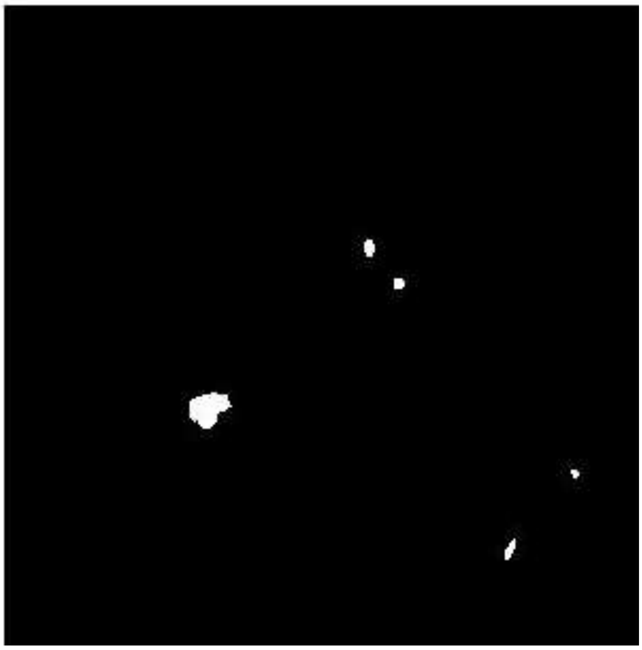

Fig 8.ROI Segmentation

2.4. Feature Extraction

The aim of Feature extraction is to remove redundancy from data. I am extracting GLCM texture features from pre-processed image. A Gray level co-occurrence matrix (GLCM) is a matrix where the number of rows and column is equal to number of gray level. It considers the relationship between two neighboring pixels, first pixel is known as reference and second pixel is known as neighbor pixel.GLCM features include Autocorrelation,Contrast,Cluster Prominence, Cluster Shade, Mean Intensity, Dissimilarity,Energy, Entropy,Homogeneity,MaximumProbability,Variance,and SumAverage.

Table 1: Feature Extraction Values Table

Feature	Value	Feature	Value
Autocorrelation	5.3811	Variance	4.0834
Contrast	0.0437	Sum Average	13.3769
Cluster Prominence	41.60987	Sum Variance	1.1709
Cluster Shade	4.0645	Sum Entropy	0.0437
Mean Intensity	0.0327	Difference Variance	0.1386
Dissimilarity	0.3888	Difference Entropy	-0.8755
Energy	1.2060	Information measure correlation 1	0.9204
Entropy	0.9855	Information Measure Correlation 2	0.9855
Homogeneity	0.9847	Inverse Difference	0.9965
Homogeneity	0.4970	Inverse Difference Moment	0.9993
Maximum Probability	5.3395		

3. CONCLUSION

In this Paper, We have developed an automated diagnosis of glaucoma system. Structural features are extracted from fundus images. Features with high t value are used for classification and found that RBF and Mayer's wavelet yield highest classification accuracy. This proposed methodology has been tested for huge database and this system is able to detect early stage of glaucoma so that it can be cured as early as possible. It is concluded that empirical wavelet based features are useful for glaucoma diagnosis.

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