International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 3 Issue 9, September- 2014

An Enhanced Glaucoma Identification using FDCT Classified by Multi SVM

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ABSTRACT— **Identifying eye diseases (GLAUCOMA) was a complicated process, this was made easy by Multi resolution analysis with the feature extraction process. Texture features within fundus images are actively pursued for accurate and efficient glaucoma classification. In this paper a novel technique proposed energy texture features extraction using CURVELET transformations which is accessible under geometry conditions where wavelets were not defined to satisfy conditions and also compared with WAVELET transformation analysis. SVM classifier is used for the classification process and feature ranking procedure under the extension of multi SVM classifier for a nonlinear classification process we access RBF kernel. This is used for obtaining accurate results. Under the above mentioned conditions the resultant accuracy is about 98.18%.**

Keywords— Glaucoma, Multi resolution analysis, Texture features, Multi SVM classifier, Curvelet transformations.

I. INTRODUCTION

Glaucoma is caused due to various diseases of eyes. It causes mostly due to the pressure on the eye and the effect is on OPTIC NERVE. The optic nerve of the eye carries visual information to the brain. The optic nerve is made up of over one million nerve cells; it is extremely thin about one twenty-thousandth of an inch in diameter. When the pressure in the eye increased, the optic nerve got damaged.

The disease is discovered in 17th century. It has been a major constraint in causing blindness from 19th century. In 1643 an entomologist named GK. Glaukoma used the entries of "cataract, opacity of lens". But according to the civilization Hippocrates this is discovered in 400 B. C.

Glaucoma is really about the problems that occur as a result of increased Intra Ocular Pressure (IOP). The average "IOP" in normal population is 14-16 mmHg. In normal population pressure is up to 20 mmHg may be within normal range.

The sick ones of glaucoma are mainly in the age group of 38 to 45 years. According to the survey of "NCBI" website around 15 million people are suffering from this disease. This is due to strain and pressure which we forcing on the eye. The database we have used is from Fried rich Alexandria University database using the following web link

http://www.cs.fau.de/research/data/fundus-images/

This university helped by providing the secured database of fundus images.

Automated clinical decision support systems (CDSSs) in ophthalmology, such as CASNET/ glaucoma, are designed to create effective decision support systems for the identification of disease in human eyes. These CDSSs have used glaucoma as a predominant case study for decades.

Such CDSSs are based on retinal image analysis techniques that are used to extract structural, contextual, or textural features from retinal images to effectively distinguish between normal and diseased samples.

The texture features are categorised into structural composition and statistical composition. Structural features are categorised into disk area, disk diameter, cup area, cup diameter, cup to disk ratio and topological features extracted from image. Pixel level information is obtained to complete any of the above mentioned schemes. So, here we are considering Statistical process for GLAUCOMA identification.

These texture features are extracted from curvelet transformations. As advancement to DWT this transformation was used. These features were classified and ranked by using Multi SVM classifier. But the existences were used for linear or nonlinear individually here SVM classifier is used for both levels of transformations.

This paper consists of seven segments Image acquisition; Image Pre-processing, Curvelet Transformation, Local Energy Theorem, Feature Extraction, Feature Selection and Classification.

The main motive of this paper is to extract the features of the image effectively and utilise them in a perfect way i.e., to trace out GLAUCOMA is present for a person or not.

II. IMAGE AQUISITION

This step is very important because the image has to be a noised freed one, which will help us to achieve better results. A good and clear image eliminates the process of noise removal and also helps in avoiding error calculation. In this case, computational errors are avoided due to absence of reflections, because the images have been taken from close proximity using fundus camera. By the help of Fried rich Alexandria University database on fundus this paper work has been completed.

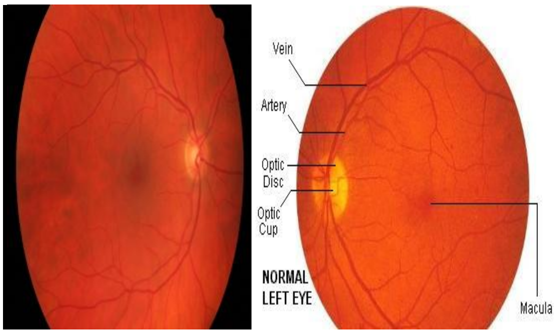

Fig 1. Left and right eye

III. IMAGE PREPROCESSING

In this section the image is under going to pre-processing stage i.e., image registration this process includes resizing the image to fix to window and converting the image into gray as we are performing the analysis on 2D images. Here we resized our to 256X256 size and converted the image into gray color or 2D by selecting the green portion of RGB this done based on pixel level processing.

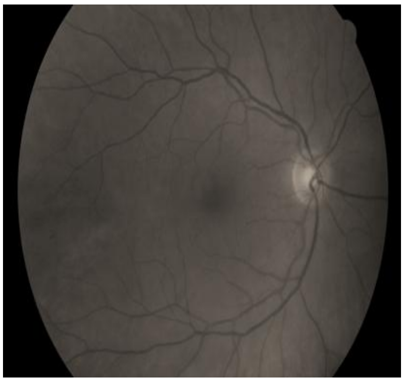

Fig 2. converting image to gray

IV. METHODOLOGY

The following methodology consists of feature extraction, feature selection, feature ranking and classification schemes. These were followed as follows

A. For feature extraction we use **Curvelet** transformation.
B. For feature calculation we use **Local Energy Theorem (LET)**.
C. For feature ranking and classification schemes we use **MULTI SVM** technique.

a) CURVELET TRANSFORMATION

In this paper curvelet transformations are used for feature extraction and filtration process. Here the decomposition process is gone through under 360^0 and this analysis is far known as angular decomposition on all frequency level with a scaling parameter **"ξ"**. The process is completely depends on the angular frequency and the scaling parameters with wedges. The process is started from left top wedge values. This helps in feature calculation, classification. The decomposition is shown in below:

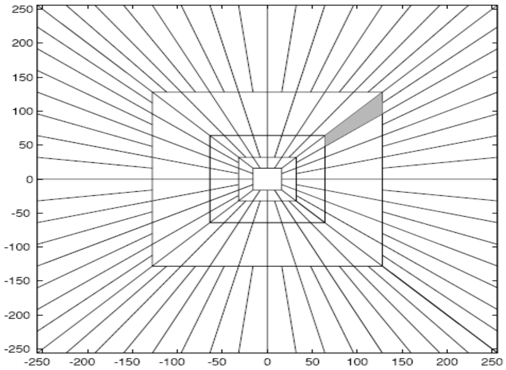

Fig 3. Decomposition using FFT

Using FFT analysis in the decomposition process to complete the initial phase later each segment is wrapped around the origin then IFFT is going to be applied. In this level it comprises of Low pass, band pass, and high pass filters, this is used for energy preservation.

Then it will make its entrance into smoothing filter, here low pass filter is used to smooth the pixel values of the wedges. Then renormalisation will takes place, here every part has been moved to unit cell. And finally ridgelet transformation has to be done on the image. This transformation has two modes one is in square mode and second is in circle mode. It is used for tiling and by using Fourier Transformation for angular transformation.

A. SUB-BAND decomposition is carried out by $f \mapsto (P_0 f, \Delta_1 f, \Delta_2 f, \Delta_3 f, \Delta_4 f, \ldots\ldots).$ (1)
B. SMOOTH partitioning is carried out by $h_Q = w_Q . \Delta_s f.$ (2)
C. RENORMALIZATION is carried out by $g_Q = T_Q^{-1} . h_Q.$ (3)
D. RIDGELET transformation is carried out by $\alpha_{(Q,\lambda)} = \langle g_Q, P_\lambda \rangle.$ (4)

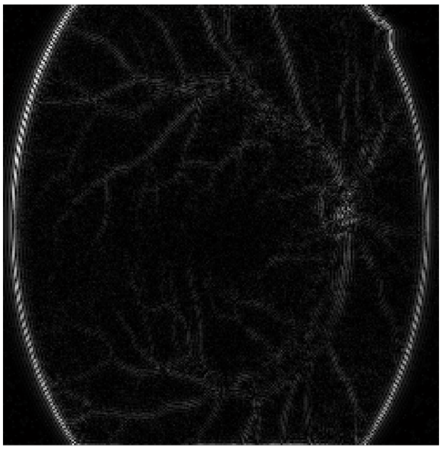

Fig 3. Curvelet transformation output

b) LET (Local Energy Theorem)

Before getting into LET there is a need to understand the concept of image texture. **Image texture** provides the information about spatial arrangement of intensities in an image or in a selected region. To analyze image texture segmentation has to be under go. By using structural approach or statistical approach these image texture are classified. Under texture we can compute (1) Angular moment, (2) Contrast, (3) Correlation, (4) Entropy and (5) Energy. All the mentioned five calculating values are under Statistical approach. So we are moving with the statistical approach and calculating energy values after considering the real valued output of Curvelet transformation.

$$ENERGY = \frac{1}{m^2 + n^2} \sum_{m} \sum_{n} I(x, y)^2 \qquad (5)$$

c) SVM (Support Vector Machine)

FEATURE ranking and FEATURE selection process are carried by MULTI SVM here C, GAMMA functions used to rank the features and select them under five fold cross validation technique. Classification process is also carried of SVM this made possible of obtaining 96.75% to wavelets and 98.18% to curvelets based on feature extraction, feature selection and feature ranking process.

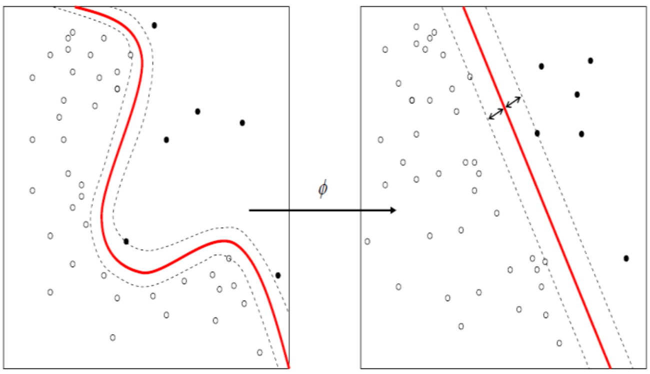

Fig 4. Nonlinear SVM classifier

SVM is a binary classifier which takes the values ± 1. This consists of multiple classes based on the dataset and one class is chosen from the rest. Multi class svm is used for maximal output so it uses sgn function.

$$argmax\ g^{jx}(x), where\ g^{jx}(x) = \sum_{i=1}^{m} y_i \propto_j^i k(x, x_i) + b^j$$

The feature ranking process is carried out in the initial stage of training process. Under this decision function has been executed and carried to classification process.

$$f(x) = sgn\left(r^2 - \left\{k(X, X) - 2\sum_{i=1}^{m} \propto_i k(x, x_i) + \sum_{i,j=1}^{m} \propto_i \propto_j k(x_i, x_j)\right\}\right) \qquad (6)$$

A nonlinear Multi svm classifier under RBF kernel has been used for implementation and feature selection is carried by equation (7)

$$K(X_i, X_j) = exp\left(-\gamma \left\|X_i - X_j\right\|\right)^2 \qquad (7)$$

Here K stands for kernel function.

V. IMPLEMENTATION

The entire process is executed under MATLAB 2012(b) GUI along with the help Curvelet transformation toolbox which has been extracted from www.curvelets.org/

STEP 1: Select input Fundus image.
STEP 2: Image normalisation
1. Resizing image into 256X256.
2. Converting image from RGB to GRAY or select GREEN value from RGB image.
STEP 3: Applying Curvelet Transformation
1. Sub band Decomposition using FFT.
2. Smooth Partitioning using High, Low, Band pass filters.
3. Reconstruction is performed.
4. Ridgelet Transformations is applied to find and smooth all the edges.
STEP 4: Selecting the real values from the output image of transformation.
STEP 5: Texture feature Energy calculation.
STEP 6: Feature Extraction for entire dataset.
STEP 7: Training entire Feature extracted dataset using Multi SVM train.
STEP 8: Calculating Accuracy depends on Multi SVM Classify using RBF for the entire dataset.

Comparative analysis between Curvelet transformations and different wavelet transformations.

Table1: Features and corresponding P-values.

FEATURE	NORMAL	GLAUCOMA	P-Value
Db h1 avg	1.0±0.3	0.98±0.2	<0.0001
Db v1 energy	4.53e±3.23e	0.123±0.1	<0.0001
SYM2 h1 avg	1.0±0.3	0.98±0.2	<0.0001
SYM3 v1 energy	4.53e±3.23e	0.123±0.1	<0.0001
Bior3.3 h1 avg	1.53±0.2	0.472±0.345	<0.0001
Bior3.5 v1 energy	3.53e±3.23e	1.23e±0.0132	<0.0001
CURVELET Energy	6.03e±7.35e	8.302e±7.35e	<0.0001

VI. RESULTS

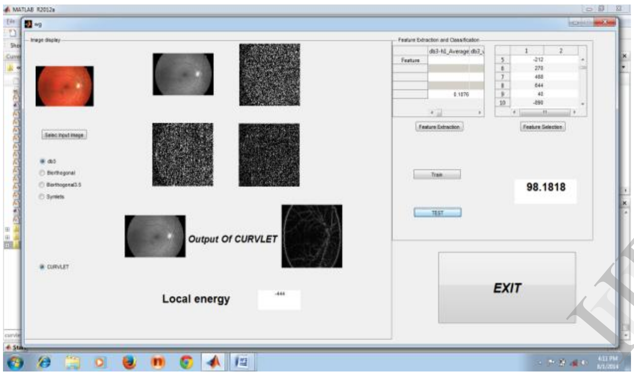

Fig 4. RESULT FOR CURVELET TRANSFOMATION

VII. FUTURE WORK

Here the proposed work is mainly on multi resolution analysis with texture feature extraction for a reason of future work these can be mostly explained by using neighbouring pixel calculation with component analysis or by using enhancing pixel under genetic calculations.

VIII. CONCLUSION

In this paper a filtration process with local energy theorem of rare combination is provided on all edges of 0^0 – 360^0. This is done possible by using CURVELET transformations. Because curvelet transformations are used for multi resolution analysis so it needs to integrate all 360^0. With the combination of SVM curvelet provides an accuracy of 98.18% this make the system is all set ready for every kind of fundus image data base for detecting glaucoma.

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