An Enhanced Blood Vessel Detection Using Curvelet Transform Classified By Scoring Algorithm

G.Divya Harika¹, P. L. S. Narasimha Rao²
¹PG Scholar, Dept of ECE, DVR & Dr. HS MIC College of Technology, JNTUK, Kanchikacherla, AP, India
²Assistant Professor, Dept of ECE, DVR & Dr. HS MIC College of Technology, JNTUK, Kanchikacherla, AP, India.
Email: dgorantla8@gmail.com plsnarasimharao@gmail.com

ABSTRACT

Tracing and edge detection supported by many methods but tracing and detecting edges under filtration process is novel idea which reduces the noise ratio. The existing methods are helped in detecting the edges and tracing them. But the novel idea process is to free the image from noise and detect the exact edges of fundus eye image. The method proposes with firstly image has to be convert into HSV (HUE SATURATION AND VALUE or ILLUMINATION) from RGB (RED GREEN BLUE) format. In the very next the image is enhanced by using adaptive histogram function from matlab. After that the image is adjusting for LUMINOSITY and for CONTRAST. From here the detection of edges under different process is proposed such as SOBEL, PERWITT, CANNY and some extensive algorithms such as KRISH algorithm, and the proposed technique (CURVELET TRANSFORMATIONS). Finally these edge detection methods were under goes to scoring classification process where these outputs were calculating and all the experimental results shows the proposing method is best in finding the exact edges and improving accuracy.

Keywords—hsv, rgb, luminosity, contrast, sobel, perwitt, canny, Kirsch algorithm, curvelet transformations, scoring classifier

I. INTRODUCTION

Edges are significant changes of local intensity in an image. This typically occurs on the boundary between two different regions in an image. The aim is to produce a line drawing of a scene from an image of that scene. This helps in extracting corners, lines and curves. These features are used by higher level computer vision algorithms for recognition or detecting objects.

The geometric and non-geometric events causes in intensity changes. Such as object boundary, surface boundary, specularity, shadows, inter reflections. The discontinuity in depth and surface
orientation of color and texture, direct reflection of light and from other objects are some of the examples to explain the edges in a scene which is captured as image. 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.

A comparison study of well known edge detection methods (Sobel, Prewitt, Canny, LoG, ZeroCross, Roberts) for binary images revealed that these methods have a tendency to distort images, especially under noisy conditions, with some methods exhibiting image distortion even under noiseless conditions. While Sobel, Prewitt, and Canny performed better overall, it was observed that they do not completely filter out noise (Gaussian, Poisson, Salt & Pepper, and Speckle) [2].

Retinal vessel detection is an important step in diagnosing and treatment of many diseases affecting the retina. The method presented in this work helps in automated extraction of retinal vessels and aids in early detection of diseases like diabetic retinopathy.

Since the curvelet transformation can represent edges efficiently, the curvelet transform coefficients are modified to enhance the image. Segmentation is done by Support vector Machine which classifies each pixel as vessel or non-vessel, based on the feature vector of the pixel. The segmentation's performance is measured in terms of accuracy, sensitivity and specificity [3].

Boundary detection is a fundamental computer vision problem that is essential for a variety of tasks, such as contour and region segmentation, symmetry detection and object recognition and categorization. We propose a generalized formulation for boundary detection, with closed-form solution, applicable to the localization of different types of boundaries, such as object edges in natural images and occlusion boundaries from figure 3 [4].

Different sections discussing in this paper are section 2 indicates the block diagram architecture, section 3 indicates curvelet transformation algorithm, section 4 discusses the results for edge detections, section 5 discusses conclusion and future work of the project and references helped to complete this project. The method presented in this work helps in automated extraction of retinal vessels exhibiting image distortion even under noiseless conditions. It was observed that they completely filter out noise.
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.

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. Classified using Scoring algorithm.

(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 $\xi$. 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.2: Curvelet transformation

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[5].

Then it will make its entrance into smoothing filter, here low pass filter is used to smooth the pixel values of the edges. 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
\[ h_Q = w_Q \cdot \Delta_s f. \]  
(2)

C. RENORMALIZATION is carried out by
\[ g_Q = T_Q^{-1} \cdot h_Q. \]  
(3)

D. RIDGELET transformation is carried out by
\[ \alpha_{(Q,\lambda)} = \langle g_Q, p_\lambda \rangle. \]  
(4)

\[ \hat{\omega}(v) = \sqrt{\hat{h}_{j+1}^2(v) - \hat{h}_j^2(v)} \forall j \geq 0, \text{ and } \hat{\omega}(v) = \hat{h}(v_1)\hat{h}(v_2) \]  
(1)

(b) SCORING ALGORITHM

**Scoring Algorithm:**

Step1: For i=1, . . . ,m, size of rows
Step2: For j=1, . . . ,n, size of columns
Step3: if u(i,j) is greater than t , verifying pixel value is greater than threshold
Step4: then R2(i,j)=255, then image pixel value is equal to 255
Step5: and k1=k1+1; calculating positive values
Step6: else
Step7: then R2(i,j)=0, then image pixel value is equal to 0
Step8: and l1=l1+1, calculating negative values
Step9: end of if else statement
Step10: end of column loop
Step11: end of row loop

**Accuracy**

\[ \text{Accuracy} = \frac{k_1 + k_1}{l_1 + l_1 + l_1 + l_1} \]  
(1)

\[ \text{Accuracy} = \frac{k_1}{2 * l_1} \times 100 \]  
(2)

Fig.3: Curvelet transformation output

The continuous-space definition of the CurveletG2 uses coronae and rotations[6] that are not especially adapted to Cartesian arrays. It is then convenient to replace these concepts by their Cartesian counterparts, that is, concentric squares and shears (instead of concentric circles) and shears (instead of rotations).
V. IMPLEMENTATION

![Block diagram](image-url)  
**Fig.4:** Block diagram

Image has been extracted from biometrics.org and from Alexandria university from Columbia for dataset these two websites helped to complete the project and obtain the results. Convert the RGB image to the equivalent HSV image.

RGB is an m-by-n-by-3 image array whose three planes contain the red, green, and blue components for the image. HSV is returned as an m-by-n-by-3 image array[7] whose three planes contain the hue, saturation, and value components for the image.

This can be done by using a matlab function “rgb2hsv” from matlab image processing toolbox. Converting HSV to Gray color image to make image more prominent to access. HSV is an m-by-n-by-3 image array whose three planes are converting into Gray color image which is an m-by-n array image or two dimensional images.

Select the value from HSV model for illumination state. Image enhancement is done here by using contrast and illumination improvement by using adaptive histogram equalization method. From matlab we use “adaphisteq” from matlab image processing toolbox. Applying threshold by using “graythres” function from matlab toolbox to improve the intensity values of the pixels and helps in detecting the blood vessels of the image more accurately. A grayscale or a binary image I as its input, and returns a binary image BW of the same size as I, with 1’s where the function finds edges in I and 0's elsewhere.

**SOBEL:** The Sobel method finds edges using the Sobel approximation to the derivative. It returns edges at those points where the gradient of I is maximum.

**CANNY:** The Canny method finds edges by looking for local maxima of the gradient of I. The gradient is calculated using the derivative of a Gaussian filter. The method uses two thresholds, to detect strong and weak edges, and includes the weak edges in the output only if they are connected to strong edges. This method is therefore less likely than the others to be fooled by noise, and more likely to detect true weak edges.

**KRISH ALGORITHM:** Edge detection through Kirsch template is to produce an image containing grey level pixels of value 0 or 255. The value 0 of pixel grey indicates a black pixel and the value 255 indicates a white pixel. Edge information of a particular and target pixel is checked by determining the brightness level of the neighbouring pixels[8].
The entire process is processed using MATLAB 2012(b) 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
Sub band Decomposition using FFT.
2. Reconstruction is performed.
3. 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: Applying the threshold factor and enhancing the edges or blood vessels of our image.

VI. RESULTS

Table 1: Scoring algorithm accuracy for different images

<table>
<thead>
<tr>
<th>Edge detection by Curvelet transformation</th>
<th>Positive values</th>
<th>Negative values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>87.72</td>
<td>51.87</td>
</tr>
<tr>
<td></td>
<td>82.55</td>
<td>50.82</td>
</tr>
<tr>
<td></td>
<td>96.31</td>
<td>50.86</td>
</tr>
<tr>
<td></td>
<td>91.09</td>
<td>50.85</td>
</tr>
</tbody>
</table>
VII. 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 $360^0$. In detecting edges of fundus image CURVELET transformation played an important role to remove the noise and this improves the accuracy of image in identifying the images. So, the limitation is calculating the accuracy for only one image not for an entire data set to avoid this the future work can be done by using adaboost classifier, Neural network classifier, SVM classifier, Lasso classifier. It improves 1.25% from the existing method in finding edges as the accuracies are mentioned in the above table 1. By using this transformation blood vessel detection made very this will help in identifying various eye diseases such as Glaucomatous using cup disc ratio.

VIII. REFERENCES


[4] Leord


Author’s Profile:

G. Divya Harika received the B.Tech Degree in Electronics and Communication Engineering from Jawaharlal Nehru Technological University (JNTU) Kakinada, in 2012 where she is pursuing the M.Tech degree in Digital Electronics and Communications systems. Her current research area focuses on Image Processing.
Mr. P.L.S. Narasimharao working as Assistant Professor in DVR & Dr. HS MIC college of Technology, Kanchikacherla, Krishna district. He has 2 years of Experience. He has completed B.Tech (ECE) from Sri Sunflower College of Engineering and Technology & M.Tech from Anurag engineering college & has done specialization in Embedded Systems in Anurag Engineering College affiliated to JNTUH. His fields of interest are Embedded Systems, Signal Processing, Communication Networks, Digital Electronics etc.