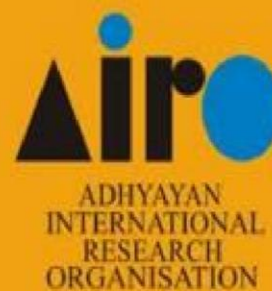


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# DESIGN AND IMPLEMENTATION OF AN IMAGE PROCESSING MODEL FOR THE ANALYSIS OF DIABETIC NEPHROPATHY IMAGES

Shreesha Kalkoor M., Research Scholar, Sunrise University, Rajasthan  
Under the Guidance of: Dr. Sachin Saxena, Supervisor, Sunrise University, Rajasthan

**Abstract**— Pictures are the most common and convenient means of conveying or transmitting information. A picture is worth a thousand words. Pictures concisely convey information about positions, sizes and inter-relationships between objects. They portray spatial information that we can recognize as objects. Human beings are good at deriving information from such images, because of our innate visual and mental abilities. About 75% of the information received by human is in pictorial form.

In the present research, the analysis of pictures that employ an overhead perspective, including the radiation not visible to human eye are considered.

Thus our discussion will be focusing on analysis of Diabetic Nephropathy images. These images are represented in digital form. When represented as numbers, brightness can be added, subtracted, multiplied, divided and, in general, subjected to statistical manipulations that are not possible if an image is presented only as a photograph.

**Keywords**— Contrast Enhancement, Image Enhancement, BIHE, CLAHE, Cell Detection, Watershed Segmentation and Image Segmentation.

## I. INTRODUCTION

Diabetic Nephropathy is the leading cause of chronic renal disease and a major cause of cardiovascular mortality. Diabetic Nephropathy has been categorized into stages: micro albuminuria and macro albuminuria. Nephropathy is pathologically characterized in individuals with type diabetes by thickening of glomerular and tubular basal membranes with progressive mesangial expansion (diffuse or nodular) leading to progressive reduction of glomerular filtration surface. It increases risk of death, mainly from cardiovascular causes and is defined by increased urinary albumin excretion (UAE) in the absence of other renal diseases.

## II. BLOCK DIAGRAM OF THE IMPLEMENTED METHOD

The brief explanation of each block is explained as follows:

### A. Original Image

This step is used to acquire or reads a grayscale or color image from the file specified by the string filename.

### B. RGB To Gray Conversion

rgb2gray(RGB) converts the true color image RGB to the grayscale intensity image I. rgb2gray converts RGB

images to grayscale by eliminating the hue and saturation information while retaining the luminance

### C. Image Enhancement

Using an image of glomerular cell, this example illustrates how you can enhance an image to correct for non-uniform illumination, and then use the enhanced image to identify the cell clearly. This enables you to learn about the characteristics of the cell and easily compute statistics for all the individual parts in the image.

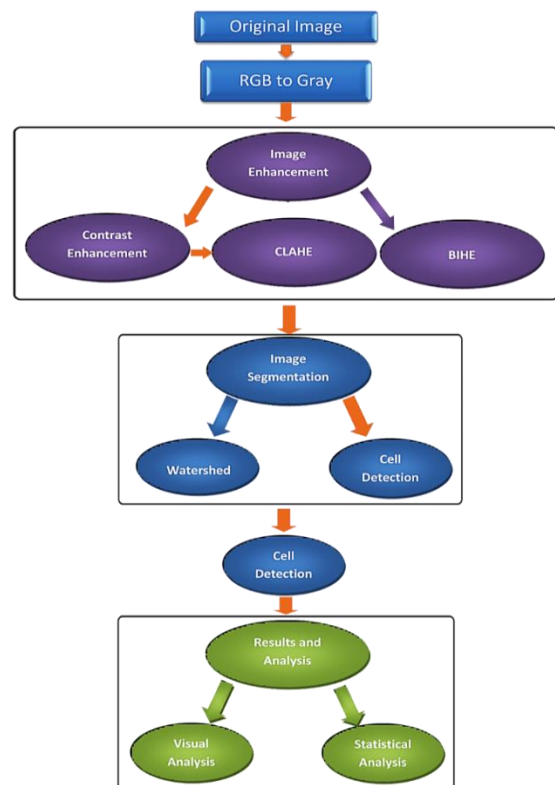


Fig. 1 Block Diagram of the implemented method

### D. Contrast Enhancement

imadjust increases the contrast of the image by mapping the values of the input intensity image to new values such that, by default, 1% of the data is saturated at low and high intensities of the input data.

### E. Histogram Equalization

histeq performs histogram equalization. It enhances the contrast of images by transforming the values in an intensity image so that the histogram of the output image approximately matches a specified histogram (uniform distribution by default).

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## F. Contrast Limited Adaptive Histograms Equalization

adapthisteq performs contrast-limited adaptive histogram equalization. Unlike histeq, it operates on small data regions (tiles) rather than the entire image. Each tile's contrast is enhanced so that the histogram of each output region approximately matches the specified histogram (uniform distribution by default). The contrast enhancement can be limited in order to avoid amplifying the noise which might be present in the image.

## G. Image Segmentation

Segmentation is often the critical step in image analysis: the point at which we move from considering each pixel as a unit of observation to working with *objects* (or parts of objects) in the image, composed of many pixels. If segmentation is done well then all other stages in image analysis are made simpler.

## H. Watershed Segmentation

Watershed segmentation to separate touching objects in an image. The watershed transform is often applied to this problem. The watershed transform finds "catchment basins" and "watershed ridge lines" in an image by treating it as a surface where light pixels are high and dark pixels are low.

## I. Cell Detection Segmentation

This shows how to detect a cell using edge detection and basic morphology. An object can be easily detected in an image if the object has sufficient contrast from the background. In this example, the cells are prostate diabetic nephropathy cells.

## III. RESULTS AND DISCUSSION

In this step analysing the visual parameters and also calculated the statistical parameters with the help of Medical Image Processing and Visualization (MIPAV) software

### A. Pseudo Code

- Step1: Read original image from the data base.
- Step2: Conversion of original colour image into gray image.
- Step3: Enhancing the converted gray image using Contrast Enhancement technique
- Step4: Enhanced Image in the first pass subjected to CLAHE
- Step5: Finding the edges of grayscale image by using Laplacian of Gaussian method
- Step6: Create a linear structure element using strel() function
- Step7: Dilate the image

- Step8: Fill the holes in the image
- Step9: Clear the light structures associated to the image border
- Step10: Create a structural element using diamond function
- Step11: Erode the greyscale in the image
- Step12: Find the perimeter of the cell in the binary image.
- Step13: Analysis using statistical values.

### B. Algorithm Description

The image that is obtained from the Electron Microscopy is taken as the input image. Here we have taken the image of Glomerular cell. Generally the image is RGB image. So the RGB image is processed using the MATLAB software and the image undergoes several algorithms to get a better output. Initially the RGB image is converted into grey scale to avoid complex calculations. Next step is to perform the enhancement of gray image by using contrast enhancement techniques. After these steps are finished then the main step, cell detection segmentation is performed. Cell detection is the edge base segmentation method by using the Laplacian of Gaussian method. In the next step it creates the structural element and then dilate and fill the gaps present in the images and finally erode the greyscale in the image to give the perimeter of the cell in the binary image.

### C. Visual Analysis

The images shown below are electron-microscopic images of glomerular cells. Fig. 2(a) and 2(b) are the images of healthy cell and diabetes affected cell respectively. Images represented below represents healthy and affected cell using existing technique (Watershed).

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## 1) Watershed Method

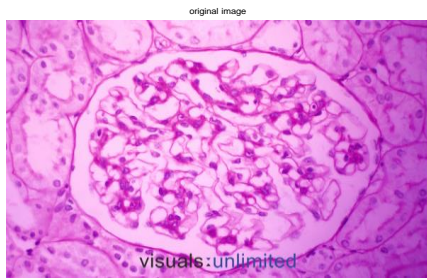


Fig. 2(a) Original Image showing the healthy condition of Base Membrane

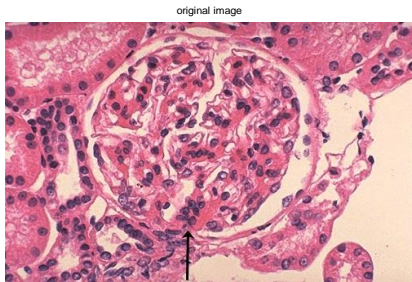


Fig. 2(b) Original Image showing mild expansion of Base Membrane

The above images are original Healthy and Disease affected electron microscopic images. In the first image by the visual inspection we can observe that the base membrane is not thick and the Macula Densa cells are not severe. In the fig. 2(b), It is clear from the visual inspection that Basemembrane is slightly thickened and the macula densa cells (Black in color) are also denser.



Fig. 3(a) Grey converted Image of Figure 2(a)



Fig. 3(b) Grey converted Image of Figure 2(b)

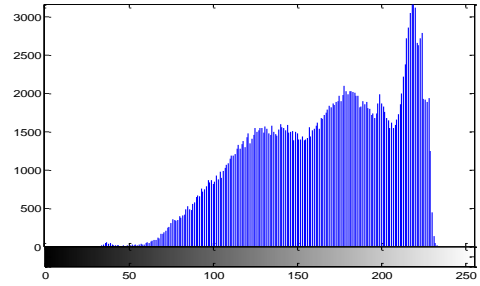


Fig. 4(a) Histogram of Figure 3(a)

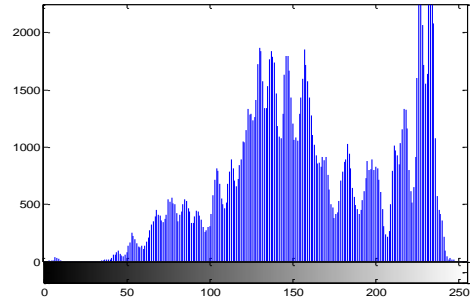


Fig. 4(b) Histogram of Figure 3(b)



Fig. 5(a) Contrast Enhanced Image

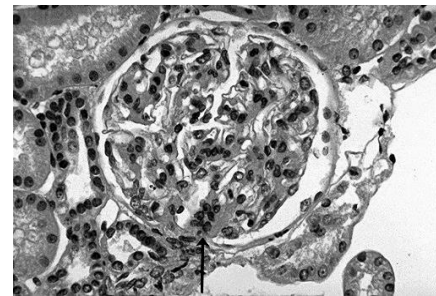


Fig. 5(b) Contrast Enhanced Image

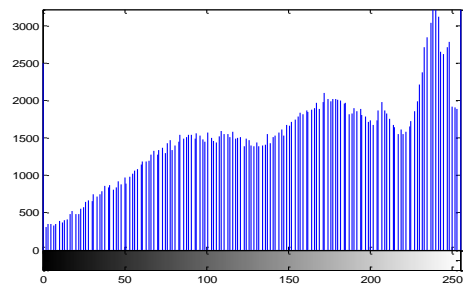


Fig. 6(a) Histogram of Figure 5(a)

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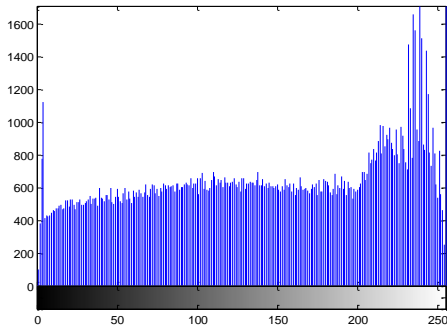


Fig. 6(b) Histogram of Figure 5(b)

The above images represent the histogram informations of Fig. 5(a) and Fig. 5(b) respectively.



Fig. 7(a) Gradient magnitude filtered image

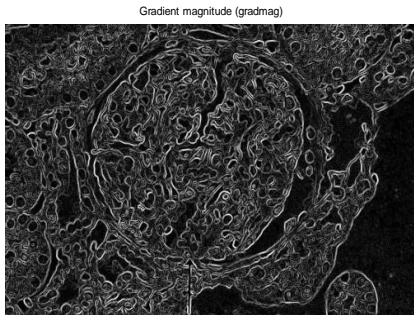


Fig. 7(b) Gradient Magnitude filtered image

The above images are the outputs of gradient magnitude filtering.

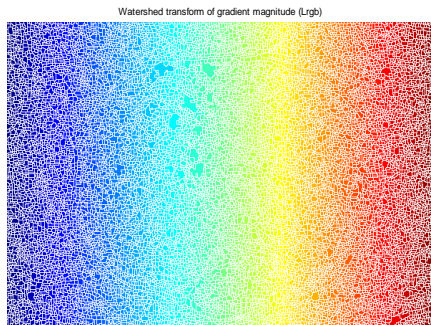


Fig. 8(a) Watershed transform of the gradient image(Figure 7(a))

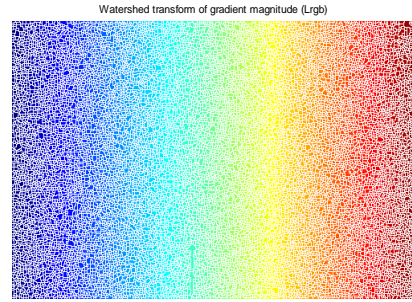


Fig. 8(b) Watershed transform of the gradient image (Figure 7(b))

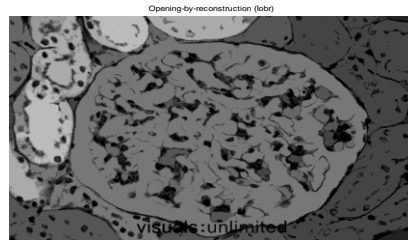


Fig. 9(a) Morphological opening reconstructed image

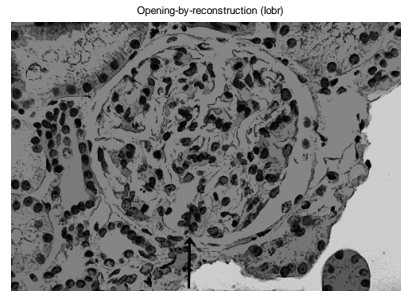


Fig. 9(b) Morphological opening reconstructed image



Fig. 10(a) Image with markers and object boundaries superimposed on original image

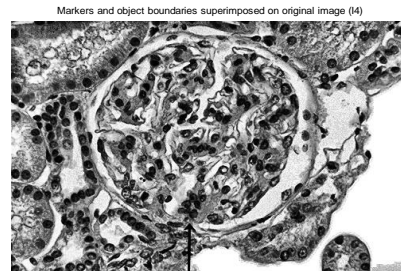


Fig. 10(b) Image with markers and object boundaries superimposed on original image

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Fig. 11(a) Output Image showing RGB superimposed transparently on original image

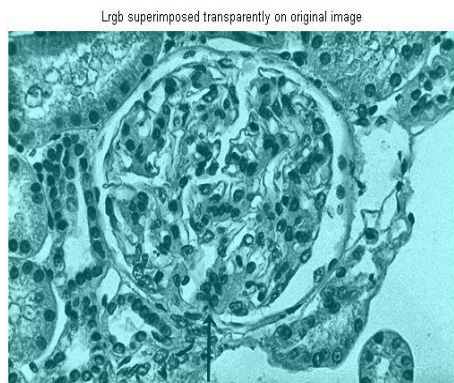


Fig. 11(b) Output Image showing RGB superimposed transparently on original image

The above images are the outputs of watershed transformation technique of the glomerular cells.

## IV. CONCLUSION

In this paper, a new algorithm is proposed to analyse the underlying problems present in acquired images of Diabetic Nephropathy. Here pre-processing techniques like Contrast Enhancement, Image Enhancement, BIHE and CLAHE as well as post-processing techniques like Cell Detection, Watershed Segmentation and Image Segmentation are used. By combining these two techniques, an adaptive image processing model for the analysis of Diabetic Nephropathy images is designed which is used for development of the frame work. This model is useful for easy analysis of Diabetic Nephropathy images. This model is also useful as an educational tool for common man. In this research work the exploration or investigation of the significance of less commonly used estimate parameters in the process of medical image analysis is done.

## REFERENCES

- [1] Renjie He, Sheng Luo, Zhanrong Jing and Yangyu Fan "Adjustable Weighting Image Contrast Enhancement Algorithm. And Its Implementation", 6th IEEE Conference on Industrial Electronics and Applications, pp.1750-1754, 2011.
- [2] Rafael C. Gonzalez, "Digital Image Processing", Second Edition, BEIJING:Publishing House of Electronics Industry, pp.11-12, 15-16, 34- 54, 2003.
- [3] V. Buzuloiu, M. Ciuc, R. M. Rangayyan, and C. Vertan, "Adaptive neighborhood histogram equalization of color images", International Journal of Electron.Image, Vol. 10, No.

- 2, pp.445-459, 2001.
- [4] P. E. Trahanias, and A. N. Venetsanopoulos, "Color image enhancement through 3-D histogram equalization", 11th IAPR Conference on Pattern Recognition, pp.545-548, 1992.
- [5] E. Bullmore, M. Brammer, G. Rouleau, B. Everitt, A. Simmons, T. Sharma, S.Frangou, R. Murray, and G. Dunn. Computerized brain tissue classification of magnetic resonance images: A new approach to the problem of partial volume artifact. *NeuroImage*, 2:133{147, 1995.
- [6] C.A. Cocosco, V. Kollokian, R.K.-S. Kwan, and A.C. Evans. Brainweb: Online interface to a 3D MRI simulated brain database. *NeuroImage*, 5(4):S425, 1997.
- [7] D.L. Collins, A.P. Zijdenbos, V. Kollokian, J.G. Sled, N.J. Kabani, C.J. Holmes, and A.C.Evans. Design and construction of a realistic digital brain phantom. *IEEE Transactions on Medical Imaging*, 17(3):463{468, 1998.
- [8] F. Malmberg. Segmentation and Analysis of Volume Images, with Applications. Swedish University of Agricultural Sciences, 2008.
- [9] H. Li, A. Elmoataz, J. Fadili, and S. Ruan. An Improved Image Segmentation Approach Based on Level Set and Mathematical Morphology. Huazhong University of Science and Technology, Department of Electronics and Information Engineering, 2003.
- [10] A. Gavlasov 'a, A. Proch 'azka, and M. Mudrov 'a. Rotation Invariant Transforms in Texture Feature Extraction. Institute of Chemical Technology in Prague, Department of Computing and Control Engineering, 2006.
- [11] T. ˇ Cervinka, and I. Provazn 'ik. Pre-processing for Segmentation. of Computer Tomogra- phy Images. The Faculty of Electrical Engineering and Communication Brno University of Technology,Department of Biomedical Engineering, 2007.