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Detection of Cardiac Complications in Diabetic Patients using Clahe Method

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Abstract**: Today, there is almost no area of technical endeavor that is not impacted in some way or the other by digital image processing. The principle objective of enhancement is to process an image so that the result is more suitable than original image for specific application. When an image is processed for visual interpretation, the viewer is the ultimate judge of how well a particular method works. Histograms, basis for numerical spatial domain processing techniques provides useful image statistics. These are simple to calculate in software and also lend themselves to economic hardware implementations, thus making them a popular tool for real-time image processing. The transformation or mapping of each pixel of input image into a corresponding pixel of the processed output image is called as "Histogram Equalization/ Linearization". It is "automatic", the process which is based on information that can be extracted directly from given image, without the need for further parameter specifications. The main objective of this paper is to observe enhancement of Electron micrograph image of a myocardial capillary from a diabetic patient, and to get image information, pixel regions, Contrast Limited Adaptive Histogram Equalization (CLAHE) and intensity adjustment which mainly helps to educate the diabetic patients to prevent cardiac complications i.e., Diabetic Cardiomyopathy using MATLAB.

Keywords: Diabetic Cardiomyopathy, Histogram, Intensity, Contrast

I. INTRODUCTION

Diabetic mellitus is a metabolic disorder that characterized by inability of the pancreas to control blood glucose concentration. This problem results in blood glucose levels out of normal range [2]. Cardiovascular disease is responsible for 80%of deaths among diabetic patients much of which has been attributed to CAD (coronary artery disease). However, there is an increasing recognition that diabetic patients suffer from an additional cardiac insult termed 'diabetic cardiomyopathy' [3]. Diabetic cardiomyopathy is a distinct primary disease process, independent of coronary artery disease, which leads to heart failure in diabetic patients. Epidemiological and clinical trial data have confirmed the greater incidence and prevalence of heart failure in diabetes [4].The ultimate aim in a large number of image processing applications is to extract important features from the image data, from which a description, interpretation, or

Understanding of the scene can be obtained for human viewers, or to provide `better' input for other automated image processing techniques [1]. Enhancement is a fundamental task in digital image processing and analysis, aiming to improve the appearance of image in terms of human brightness perception [5]. Image enhancement techniques are designed to improve the quality of an image as perceived by a human being. The principle objective of enhancement is to process an image so that the result is more suitable than the original image for a specific application. The image enhancement is one of the most interesting and visually appearing areas of image processing. Histogram analysis is one of the image enhancement techniques. Histogram based techniques for image enhancement is mostly based on equalizing the histogram of the image and increasing the dynamic range corresponding to the image[6].It provides useful image statistics and the information inherent in histograms is also quite useful in other image processing application such as image compression and segmentation [1].

II. HISTOGRAM

A graphical tool developed by Statisticians to visualize frequency distributions, it has a very specific meaning when used in the context of digital images. We go with black and white images, in which each pixel has a specific brightness level which is stored in the computer as a number between 0 and 255.Zero corresponds to black and 255 to white.

Histogram processing are of two types

A. Histogram Equalization (HE)
B.Contrast Limited Adaptive Histogram Equalization (CLAHE)
C.Intensity Adjustment

B. Histogram Equalization (HE)
Histogram equalization employs a monotonic, non-linear mapping which re-assigns the intensity values of pixels in the input image such that the output image contains a uniform distribution of intensities (i.e. a flat histogram).It is a common technique for enhancing the appearance of images. A perfect image is one which has equal no. of pixels in all its gray levels. Hence to get a perfect image our objective is not only to spread the dynamic range but also to have equal pixels in all the gray levels. This technique is known as Histogram Equalization[1].

C. Contrast Limited Adaptive Histogram Equalization (CLAHE)
While HE works on the entire image, CLAHE operates on small regions in the image, called tiles. Each tile's contrast is enhanced, so that the histogram of the output region approximately matches a specified histogram.

D. Intensity Adjustment
It is used to improve an image the brightness of the image depends on the value associated with the pixel of the image. When changing the brightness of the image, a constant is added or subtracted from the luminance of all sample values. The brightness of the image can be increased by adding a constant value to each every pixel of the image. Similarly the brightness can be decreased by subtracting a constant value from each and every pixel of the image.

III. SIMULATION RESULT

The proposed method mainly deals with enhancement of Electron micrograph image of a myocardial capillary from a diabetic patient .The main pathology in diabetic patients is that basement membrane of a blood vessel is going to be thickened making blood vessel narrower . This leads to reduction in flow of blood. Hence The Heart gets Ischemia or Hypoxia i.e. due to lack of oxygenation. Further narrowing leads to myocardial death i.e. Heart Failure.Fig 1.shows original image in which the visibility thickening of basement membrane is not so clear.

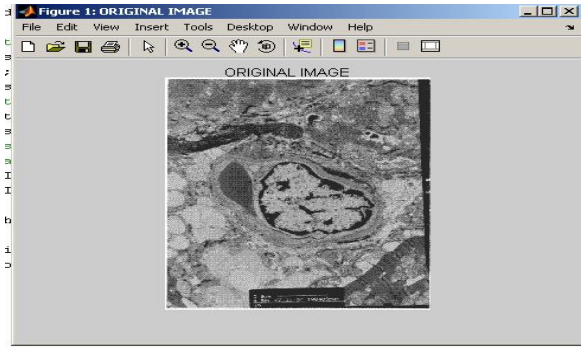


Fig 1. Electron micrograph image of a myocardial capillary

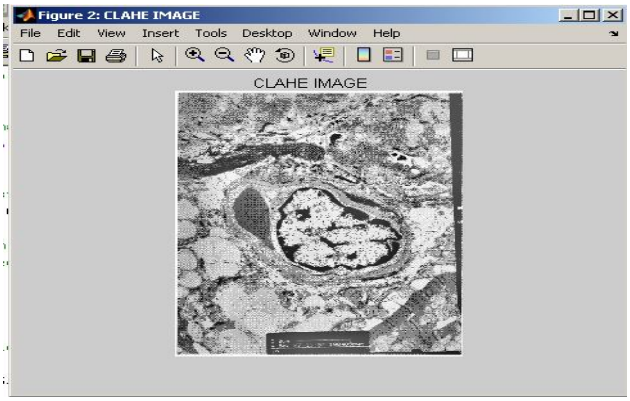


Fig 2. CLAHE image

Fig 2. image is the result of contrast limited adaptive histogram equalization (CLAHE) which is to adjust the contrast in an intensity image. In the original image the visibility of thickening of basement membrane is not so clear. CLAHE produces an output image has the clear visibility of thickening of basement membrane of blood vessel.

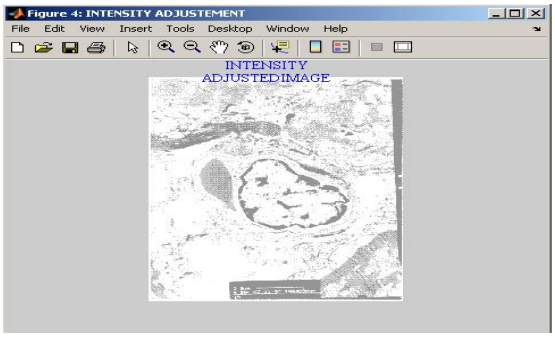
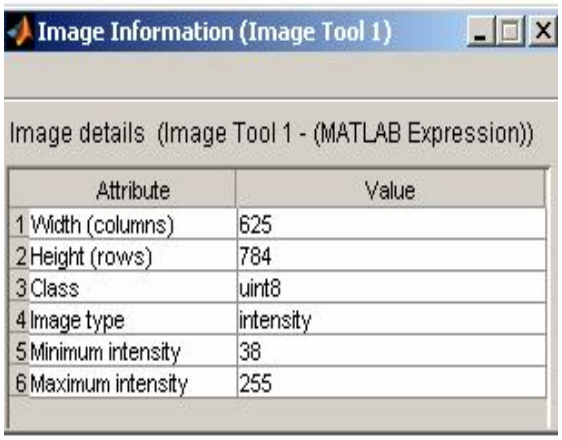


Fig 3. Intensity Adjusted Image

By adjusting the intensity range as shown in Fig 3 one can have a clear picture on the region of interest (ROI). Here the details in the blood capillary are visible clearly and neglects the other objects in image by intensity adjustment. Hence one can estimate that the part which is useful and which part has been affected. This is useful in early medical education of Diabetic patients.



	Attribute	Value
1	Width (columns)	625
2	Height (rows)	784
3	Class	uint8
4	Image type	intensity
5	Minimum intensity	38
6	Maximum intensity	255

Fig 4. Image Information

Fig 4. Shows image information which gives the details about the input image i.e. the type of the image and intensity ranges are observed in above tool bar. The Width attribute gives the information about the number of columns available in the image and Height attribute gives the information about the number of rows available in the image. Class attribute gives about which type of class of the image saved and Image type is intensity image. The minimum intensity is 38 and maximum intensity is 255.

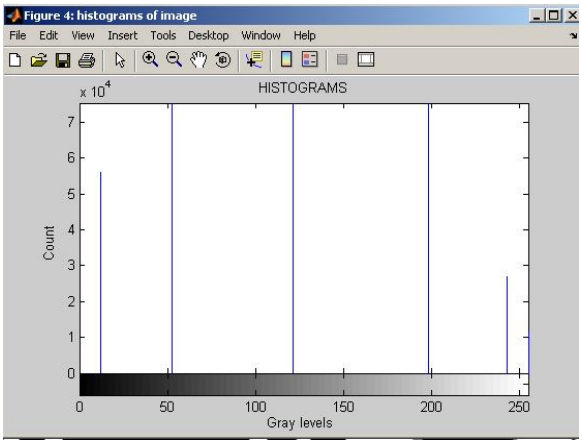


Fig 5. Histogram of image

Fig 5. represents histograms shows the distribution of pixel values (0-255) of the input image.

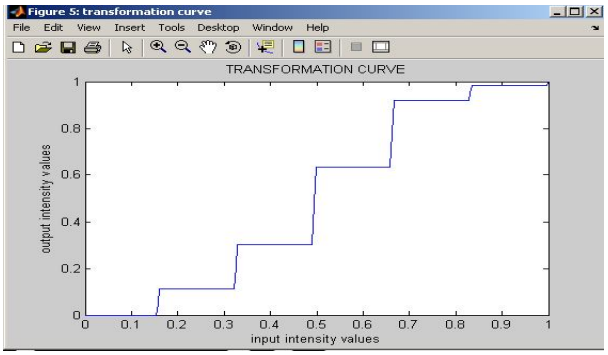


Fig 6. Transformation Curve

Fig 6. represents Transformation curve which reflects the histograms in the Fig 5. , with input values 0 and 1, while the output values are distributed evenly between 0.15 and 1.

IV. CONCLUSION

This paper mainly deals with enhancement (CLAHE) and Intensity adjustment of electro micrograph image of a myocardial capillary from a diabetic patient. The experimental results shows the thickening of basement membrane which leads to abnormal perfusion of blood. This suggests that there is an urgent need to conduct pathogenic and diagnostic studies specifically in diabetic patients to better understand the factors which initiate heart failure and to develop more effective treatments.

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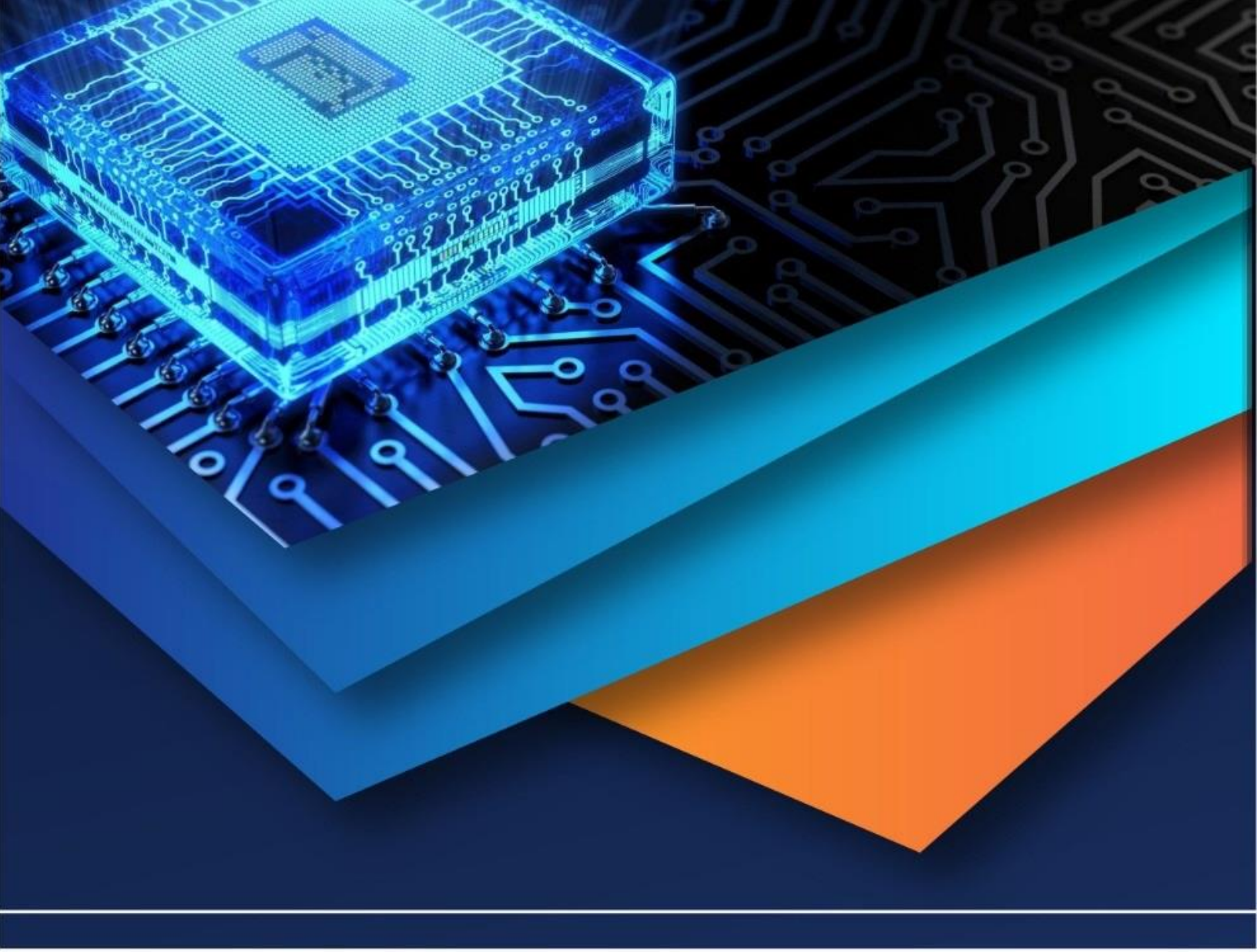

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