

# Contrast Enhancements in Diabetic Retinopathy Retinal Fundus Images- A Future Look

Teena Varma<sup>1</sup>, Dhamini Iyer<sup>2</sup>, Melita Fernandes<sup>3</sup>, Joyce Isaac<sup>4</sup>, Krupa Narvekar<sup>5</sup>

Assistant Professor, Department of Computer Engineering, Xavier Institute of Engineering, Mumbai, Maharashtra, India<sup>1</sup>

U.G. Students, Department of Computer Engineering, Xavier Institute of Engineering, Mumbai, Maharashtra, India<sup>2,3,4,5</sup>

**ABSTRACT:** Diabetic Retinopathy is one of the leading concern in the field of Ophthalmology, which can cause blindness if not diagnosed in early stages. The retinal fundus images is scanned and analysed to detect Micro-aneurysms, which are the small swellings which causes hindrance in the path of vision. This paper tries to explore and discuss some of the future challenges to enhance retinal fundus images of Diabetic Retinopathy infected eye.

**KEYWORDS:** Diabetic Retinopathy, Micro-aneurysms

## I. INTRODUCTION

Diabetic Retinopathy (DR) is a medical condition which affects the eye, as a consequence of Diabetes Mellitus. It affects the tiny blood vessels running inside the retinal screen. Due to high blood sugar levels, these vessels get affected and as a result, they start to swell and leak in nearby tissues and hence causing the red spots in the retina. These swellings are called Micro-aneurysms (MA). Nowadays, there is an increase in number of people suffering from diabetes and is expected to increase in near future. As a result, people are prone to Diabetic Retinopathy, and hence medical industry requires mass screening of the retinal fundus images. Since, the Micro-aneurysms is of order of micromillimeters, it is very difficult to detect it. In the traditional approach to detect DR, ophthalmologists dilate the pupil to widen enough to view inside the eye. It has the major drawback as it will allow more light to pass through the pupil, causing blurred vision for several hours. Recent studies have been proposed to detect Micro-aneurysms without dilating the pupil. Ranaditya Haldar[2] used Contrast Limited Adaptive Histogram Equalization (CLAHE) for preprocessing the retinal fundus image, followed by extracting blood vessel using thresholding. Automatic Exudate Detection from Non-dilated Diabetic Retinopathy Retinal Images Using Fuzzy C-means Clustering is proposed by Akara Sopharak[3]. Akara Sopharak[4] used Contrast Limited Adaptive Histogram Equalization (CLAHE) along with the optimally adjusted mathematical morphology to detect Micro-aneurysms.

## II. LITERATURE SURVEY

Histogram is a graphical representation of distribution of numerical data on a given range. It basically defines the frequency of a number on overall range of numbers. In Image Processing, histogram is used to determine the frequency of each pixel intensity value. Histogram Equalization(HE) is a basic technique in image enhancement for enhancing the contrast of the images, hereby generating uniform distribution of gray levels. It is very easy to enhance the contrast of an image but leads to loss of important information from the input image. In medical industry, these small information is a big issue and is a concern to diagnose the disease very precisely. Hence, Histogram Equalization is practically not used in any of medical image enhancement.

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Histogram Equalization technique enhances the contrast of the image globally, which leads to loss of important information from the image. Adaptive Histogram Equalization(AHE)[5] is an extension of Histogram Equalization, wherein the image is divided into smaller regions, called tiles. The contrast of each tile is then enhanced and these regions are combined using Bilinear Interpolation to eliminate artificially induced boundaries. Adaptive Histogram Equalization is rarely being used in image enhancements as they tend to over amplify the local regions, and hence causing a discontinuity between the regions on an overall aspects.

Contrast Limited Adaptive Histogram Equalization (CLAHE)[5],[7],[11] is the adaptive version of Adaptive Histogram Equalization (AHE)[12] wherein the histogram is calculated on the contextual basis of the image. Here the image is divided into contextual regions, means the regions are divided according to the relationship of a pixel with neighbouring pixels. This technique of dividing regions surely eliminated the drawback of Adaptive Histogram Equalization (AHE) of discontinuity and controlling the over amplification of the contrast of the image on overall scale. This algorithm requires two parameters to be defined: block size and clipping limit. Block size is the variable which divides the image into regions. For example for block size P, image is divided into PXP regions. Clipping limit is the threshold for altering the contrast of the image. This algorithm takes these parameters from the input, computes the contrast of image. But every time user has to give these above two parameters before the computation. Since, the clipping limit is the main parameter for enhancing the contrast of the image and incorrect clipping limit will produce undesired output, computational speed of this algorithm is slow and research is on progress on this context. Many of the studies proposed different methods to eliminate the drawback of Contrast Limited Adaptive Histogram Equalization (CLAHE)[8],[9],[10] algorithm. One of the technique proposed is Adaptively Clipped Contrast Limited

Adaptive Histogram Equalization (ACLAHE)[5]. This method tries to adaptively select the clipping limit on the basis of the input image and enhance the contrast of the input image. The steps of algorithm is as follows:

1. Divide the image into NXN regions.
2. For each region, compute its histogram and select clipping level.
3. For each pixel intensity,
  - 3.a. If pixel intensity is greater than clipping level, then clip the intensity to threshold clipping level.
  - 3.b. Collect all the pixels above the threshold clipping level and redistribute in all pixel intensities of the histogram.
4. For each pixel
  - 4.a. If the pixel belongs to Internal Region, Calculate four weights of four nearby regions, And output mapping of the pixel as weighted sum of clipped HE of these four regions.
  - 4.b. If the pixel belongs to Border Region, Calculate two weights of two nearby regions, And output mapping of the pixel as weighted sum of clipped HE of these two regions.
  - 4.c. If the pixel belongs to Corner Region, output mapping of the pixel as weighted sum of clipped HE of the region containing the pixel.
5. Apply these output mappings on the input image to get contrast enhanced output image.

### III. CONCLUSION

The above discussed algorithms belongs to spatial domain[1], which directly works on the pixels of the input image, making the computations much easier. Transformation domain is much preferred over the spatial domain of its precise and continuous computations, unlike in spatial domain which works on discrete set of values. Research is going on in the field of medical image contrast enhancement. But Transformation domain techniques of contrast enhancement takes more computational time than the spatial domain techniques. In future, Medical Image Processing will need more and more precise computation of medical images and the present algorithms will evolve in order to fulfil the requirements of the future.

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