# Enhancing Visual Quality in Wireless Capsule Endoscopy Images by using Contrast Enhancement Techniques

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**Abstract—In this paper, primarily Contrast Limited Adaptive Histogram Equalization (CLAHE) technique is used to boost the visibility of local details of low contrast image by improving the contrast of its local regions. Next, wiener filter is used as smoothing filter. Then it is followed by contrast stretching which is used for adjusting the contrast of the image. Finally, unsharp filtering is used to sharpen the obtained image. This yields enhanced image which is useful for diagnosis.**

**Keywords—CLAHE, wiener filter, contrast stretching and unsharp filtering etc.**

## 1. INTRODUCTION

Image enhancement is one of the helpful research fields in medical applications for the researchers because of extensive utilization of the images in the diagnosis purposes [1]. In non-uniform illumination conditions, the images appear darker. Visual quality in the image also affected due to uneven contrast which results in poor understanding concerning the features of the image. This process of making images more suitable is nothing but image enhancement [2].

Conversion of an image from one form to another, may lead to some form of degradation occur at processed image. Therefore, improvement in quality of images which are degraded can be generally done by applying one of the enhancement algorithms. These enhancement techniques are obviously application specific. Image enhancement methods emphasize specific features to enhance the visual quality in low contrast image. Enhancement yields an output image by varying the intensity values of the pixels in the input image [3]. Enhancement in image plays an important role in image processing applications where specific consultants get across a very critical decision which is based on this information of the image. The main motive of enhancement algorithms is to rebuild the recorded image almost same as that of true image [4].

Early treatment and detection of gastrointestinal diseases are very critical. There are also invasive procedures for diagnosis like upper endoscopy and colonoscopy [5, 6]. Wireless capsule endoscopy (WCE) is a small device and disposable capsule which aids to visualize the diseases in the small bowel, also to trace the abnormalities of the small bowel. These WCE products have also approved by FDA [7, 8]. This tiny capsule is able to send color and high fidelity images of the entire GI tract, mainly in small intestine [9].
The WCE can be helpful for diagnosis purposes, mainly due to the WCE is safe procedure as well as it is non-invasive [10].

## II. PROPOSED METHOD

In this section, the proposed design methodology is presented for the enhancing the visual quality of WCE image. The proposed system design aids in reducing the degraded noise and enhances the overall contrast. The proposed method's flow sequence is shown in Fig.1.

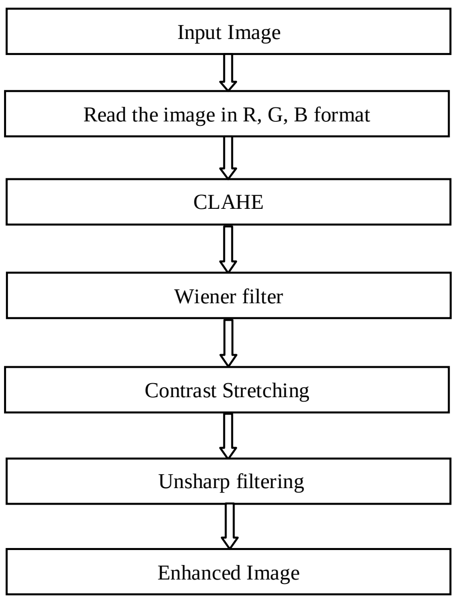


**Fig -1:** Proposed design's flow Sequence

### A. Contrast Limited Adaptive Histogram Equalization

Contrast Limited Adaptive Histogram Equalization (CLAHE) is a method for improving the perception of local details by enhancing the local region's contrast of the image. It does operate on small regions in the image which is called as tiles, whereas unlike histogram equalization, which operates on whole image. The contrast of each tile is improved, so that the histogram of region's output is approximately nearer to histogram that is specified by the 'Distribution' parameter. Then tiles of the neighbors are combined with the aid of bilinear interpolation to eliminate induced artificial boundaries. The contrast, mainly in the homogeneous areas, is limited to overcome noise amplification problems that may be present in an image. CLAHE is an enhancement technique that operates significantly better compare to the histogram equalization method in most of the images [11].

### B. Adaptive noise-removal filter (Wiener filter)

This adaptive filter is basically more selective when compare to a linear filter, since it preserves the edges of an image as well as also other high-frequency parts of the image. It is Wiener filter function, which is adaptively operated on an image and tailors itself to local variance of an image. And if variance is large, it does little smoothing and if the variance is small, it does more smoothing. And it uses adaptive wiener technique, which is depends on estimated statistics obtained from a pixel's local neighbourhood. This filter often yields better results when compare to linear filter [12]

### C. Contrast Stretching Operation

The pixel range may be random in the image. Hence, this operation is done to translate the pixels in the display range of 0 to 255 [11].

### D. Unsharp Filtering

An unsharp filter, which is a sharpening operation used to sharp the image [11]. It is one of the common techniques that is used for contrast enhancement. This is the final operation to yield enhanced image.

## III. RESULTS

The results of improved images compare to input image is shown in Fig 2.

**Table 1:** Different Quality metric parameters

| Quality metric parameter | Proposed Method |
|---|---|
| SSIM | 0.94 |
| PSNR | 22.15 |
| RMSE | 19 |

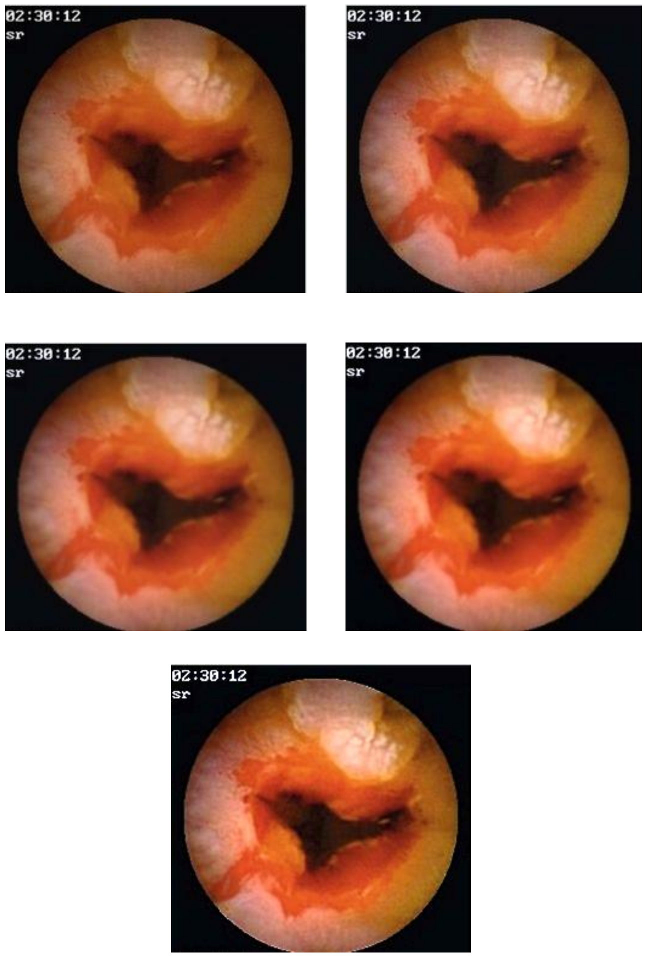


**Fig -2:** (a) Low Contrast Image, (b) after CLAHE, c) after wiener filtering, (d) after contrast stretching, (d) after unsharp filtering

## IV. CONCLUSION

In this paper**,** CLAHE technique is used to improve the visibility of local details of low contrast image by improving the contrast of its local regions. Next, wiener filter is used as smoothing filter. Then it is followed by contrast stretching which is used for adjusting the contrast in the image. Finally, unsharp filtering is used to sharpen the obtained image. This proposed design methodology can be used to enhance low contrast medical images that aids for diagnosis purposes.

ISSN:2319-6890)(online),2347-5013(print)
20 May 2016

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