A TECHNIQUE FOR VISUAL QUALITY ENHANCEMENT IN CAPSULE ENDOSCOPY IMAGES USING CONTRAST ENHANCEMENT ALGORITHMS

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Abstract

Capsule Endoscopy is a kind of technology that uses tiny disposable capsule which transmits captured images wirelessly of entire gastro-intestinal tract. The motive of proposed method is to enhance the visual quality in the capsule endoscopy images which is critical mainly for diagnosis. In this paper, primarily median filtering is done to reduce the noise. Next, Contrast Limited Adaptive Histogram Equalization (CLAHE) technique is used to boost the local details visibility by improving the contrast of its local regions. Then it is followed by unsharp filtering, used to sharpen the obtained image. Finally, contrast stretching is used for adjusting the contrast of the image. This yields the enhanced image which highlights more details as well as improves the overall contrast, which is very helpful for diagnosis.

Keywords: *Capsule Endoscopy, Median Filter, CLAHE, Unsharp Filtering and Contrast Stretching etc.*

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1. INTRODUCTION

Capsule endoscopy is a kind of technology to diagnose mainly gastrointestinal (GI) tract problems with practically no invasiveness [1]. Early treatment and detection of GI tract diseases are very critical. There are also invasive procedures for diagnosis like upper endoscopy and colonoscopy [2, 3]. This tiny capsule is able to send color and high fidelity images of the entire GI tract, mainly in small intestine [4]. The Capsule endoscopy can be helpful for diagnosis purposes, mainly due to Capsule endoscopy is safe procedure as well as it is non-invasive [5]. These Capsule endoscopy products have also approved from FDA [6, 7]. In non-uniform illumination conditions, the images appear darker. Visual quality in the image also corrupted due to uneven contrast which leads to poor understanding concerning the features of the image. This method of making images more suitable is nothing but image enhancement [8].

Enhancement is accomplished to improve the visual perception of information present in the images and also provides much suitable input for other automated processing algorithms. There are various methods that can be used to enhance an image without spoiling it [9].

Medical image processing is one of the fields of science which is obtaining large acceptance in industries like healthcare, mainly due to its technological development as well as breakthroughs of software. Also, it plays a critical role in diagnosis purposes as well as for improved care of patient [10].

Image enhancement is one of the helpful fields in medical applications due to more utilization of the images in the diagnosis purposes [11].

2. PROPOSED METHOD

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

2.1. Median filtering

If the motive is to avoid noise as well as for preserving edges simultaneously then this filtering operation is more effective compare to convolution operation. It is a common technique for enhancing the image by removing noise present in the image. Since this filter is less sensitive compare to linear filtering methods to extreme modification in pixel values, it can avoid salt and pepper noise without reducing the sharpness significantly of an image [9].

2.2. 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 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. CLAHE is an enhancement technique that operates significantly better compare to the histogram equalization method in most of the images [9].

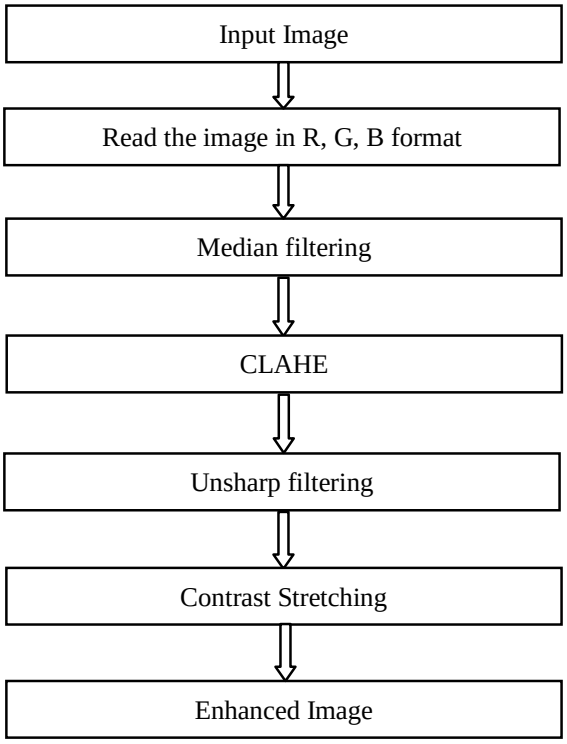

Fig -1: Proposed design's flow Sequence

2.3. Unsharp Filtering

An unsharp filter, which is a sharpening operation used to sharpen the image [9]. It is one of the common techniques which is used for contrast enhancement.

2.4. Contrast Stretching Operation

The pixel range may be random in the image. Hence, to translate the pixels in the display range of 0 to 255, this operation is done [9]. This is the final operation to yield enhanced image.

3. RESULTS

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

Table 1: Different metric parameters used for evaluation

Quality metric parameter	Proposed Method
SSIM	**0.99**
PSNR	**33.47**
MSE	**29.18**

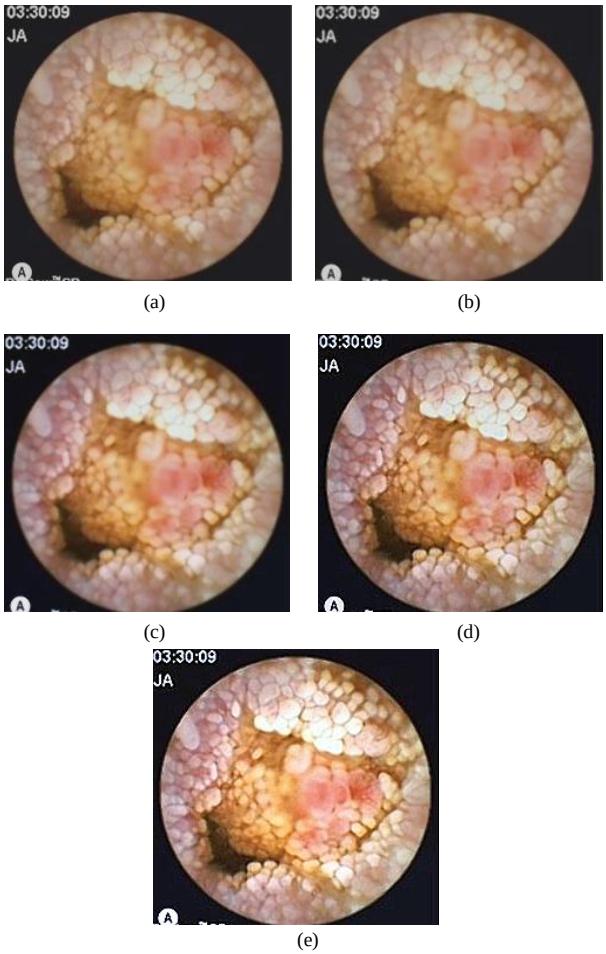

Fig -2: (a) Low Contrast Image, (b) after Median filtering, (c) after CLAHE (d) after unsharp filtering, (e) after contrast stretching

4. CONCLUSION

In this paper**,** to improve the visual quality in WCE images primarily median filtering is done to reduce the noise. Next, CLAHE technique is used to boost the local details visibility by improving the contrast of its local regions. Then it is followed by unsharp filtering, which is used to sharpen the obtained image. Finally, contrast stretching is used for adjusting the contrast of the image. This proposed design methodology can be used to enhance low contrast as well as poor quality medical images and that aids for diagnosis purposes.

REFERENCES

[1]. G. Iddan, G. Meron, A. Glukhovsky, and P. Swain, "Wireless capsule endoscopy," Nature, vol. 405, p. 417, 2000.

[2]. V. Charisis, L.J. Hadjileontiadis, C.N. Liatsos, C.C.Mavrogiannis, and G.D Sergiadis, "Abnormal pattern detection in wireless capsule endoscopy images using nonlinear analysis in RGB color space", 32nd Annual International Conference of the IEEE Engineering Medicine and Biology Society, pp. 3674-3677, 2010.

[3]. Z. Fireman, D. Paz, and Y. Kopelman, "Capsule endoscopy: Improving transit time and image view", World Journal of Gastroenterology, vol. 11, no. 37, pp. 5863-5866, 2005.
[4]. D. D. Adler and C. J. Gostout, "Wireless capsule endoscopy," Hospital Physician, pp. 14-22, May 2003.
[5]. C.Y LI, B.L Zhang, C.X. Chen, and Y.M Li, "OMOM capsule endoscopy in diagnosis of small bowel disease", Journal of Zhejiang University Science, vol. 9, no. 11, pp.857-862, 2008.
[6]. B. Li, and M.Q.H. Meng, "Wireless capsule endoscopy images enhancement using contrast driven forward and backward anisotropic diffusion", IEEE International Conference Image Processing, pp.437-440, 2007.
[7]. K. Sandrasegaran, D.D.T. Maglinte, S.G. Jennings, and M.V.Chiorean, "Capsule endoscopy and imaging tests in the elective investigation of small bowel disease," Clinical Radiology, vol. 63, pp. 712-723, 2008.
[8]. V.Vanathe, Boopathy, Manikandan," MR Image Demising and Enhancing using Multi-solution Image Decomposition Technique", Image Processing and Pattern Recognition, International Conference on Signal Processing [ICSIPRI] in 2013.
[9]. R.Gonzalez & R.Wood , Digital Image Processing' 3rd .ed. Englewood Cliffs, NJ: Prentice Hall, 2007
[10]. K. Karthikeyan and C. Chandrasekar, "Wavelet-based Image Enhancement Techniques for Improving Visual Quality of Ultrasonic Images", International Journal of Computer Applications, p.p. 0975– 8887, Vol. 39, No.17, Feb. 2012.
[11]. Klaus D. Toennies, Guide to Medical Image Analysis: Methods and Algorithms, Springer, 2012.