International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 03 | Mar-2018 www.irjet.net p-ISSN: 2395-0072

Visual Improvement of Histopathology Images using Enhancement Techniques

Dr.S.Anand[1], G.Sangeethapriya[2]

[1]Associate Professor, Department of Electronics and Communication Engineering,
[2]PG Scholar, Department of Electronics and Communication Engineering,
[1-2] Mepco Schlenk Engineering College, Sivakasi.

Abstract - *Quality histopathology images (HPI) is essential for diagnosing the diseases and it is not easy for the experts to analyze low contrast or too bright HPI due to poor representation. Histopathology images are usually degraded by improper staining process and thus low contrast, poor illumination and low visibility images. The Problem of visualization and color variation in histopathology images jointly caused by inconsistent biopsy staining and nonstandard imaging condition. In, order to overcome these limitations to build two stage adaptive histogram equalization for enhancement of histopathology images. The algorithm tested on different HPI images and compared with conventional contrast enhancement technique. Performance of proposed method is evaluated using Entropy, EME, SSIM and AMBE. Proposed method gives better results compared to contrast limited adaptive histogram equalization (CLAHE).*

Key Words: **Image Enhancement, Histopathology Images, Adaptive Histogram Equalization, Performance Measures**

1. INTRODUCTION

Image enhancement is to enhance quality of the image. So, that visual appearance can be improved. If the Contrast of a medical image is mainly focused on particular range, e.g. low contrast image; the details are possibly misplaced in those places which are excessively and intensive.

Histopathology is a branch of pathology which deals with microscopic examination biological tissues to observe the appearance of diseased cells and tissues in very fine details. Mostly these kinds of images are called microscopic images. Analysis of a histopathological images are conducted under the microscope, it will examines the sample for indications of diseases. Microscope offers even more benefits on studying pathogens that cause tissue changes or damage, as it allows them to see the level of tissue degradation present and therefore, verify the progression of the particular diseases. Discipline is absolutely vital to the understanding and detection of diseases, which ultimately broadens and progresses treatment options in the majority of instances. . Now days medical image processing is playing important role in our life, such as histopathology, mammogram images surgeries. Enhancement becomes necessary process for clinical research and diagnosis of cancer. It is the process of improving quality of image without any information loss. Main use of histopathology is clinical medicine (which is a term refers to the diagnosing, trying to treat and advise a patient) where it is typically involves the examination of biopsy samples. Importance of histopathology is accurate diagnosis of cancer and other diseases usually require histopathological examination of samples. Enhancement is necessary for diagnosing medical images to improve the visibility. Sharpening in medical images is a classic defeat in the area of image enhancement. Resolving low contrast structures is most common task performed by those interpreting medical images [1]-[5]. The construction of proposed work is based on two stage histogram equalization (TSAHE). Role of two stage adaptive histogram equalization processing is important in image enhancement. It will effective method to enhancing contrast of a medical image is becomes uniform [6]-[7]. Histopathological images are analyzed by using computerized algorithms such as machine learning techniques. Algorithm has been developed to detect and diagnosing the diseases [8]. Histogram equalization may results in large differences of the image and that of the enhanced one. Moreover, it leads to over enhancement and produce artifacts and edge effects [9]. Classical HE (CHE) is not accepted in real time applications since it does not preserve the brightness and naturalness of the image. To overcome this drawback, the variations of CHE should be considered. Technique of decomposing the input image into sub-image is known as Bi-HE (BHE). BHE method performs the image enhancement preserving brightness to some extend but the output image does not look as natural as the input ones [10]. If an image is poorly illuminated or if it is blurred, the details are misplaced or inconvenient to extract. The foremost difficult is to enhance the illumination and intensity of an image without loss of information. Different techniques exist in order to defeat this issue [11]-[12], such as general histogram equalization (GHE) and local histogram equalization (LHE) for illumination enhancement. This kind of problems are occurs in conventional image enhancement technique and it can be overcome by color image enhancement techniques. If Hue gets changed, then original color of the image gets changed thereby distorting the image [13]. For color image enhancement, it is necessary that hue value should not get changed any pixel [14]. Kuang-Tsu Shih et al., [15] has focused on color image enhancement. Here, gamut mapping algorithm is proposed. In this current approach, ahead the uniform distribution match as standard AHE, further histogram distribution used to current more hidden internal structure. This will efficacious to facilitate

the uniform distribution matching by providing more contrast information.

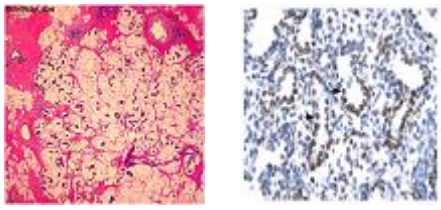

Fig -1: Shows that example of H&E and IHC Stained Images

2. Staining of Histopathology Slides

Histopathological images are processed by several ways such as Fixation, dehydration, Cleaning, Embedding, Cutting and Staining. Staining is used to highlight important features of the tissue as well as to enhance the tissue contrast. The tissues are stained with one or more stains for better visualization under the microscope.

Histopathological images are mostly used in H&E (Haemotoxylin and Eosin) and IHC (Immune histo chemistry) staining. Eosin dye is a negatively charged acidic color. It is a pink, orange and red color stain. H&E used for demonstration of nucleus (blue, purple) and cytoplasm (pink, orange) inclusions in clinical specimens. Haemotoxylin is a dark blue or violet that is positive dye. These types staining method is used to gives a general overview structure of the tissue and it can be used to better diagnosis tool. Immune Histo Chemistry (IHC) is a type of staining. This type of staining is used to diagnose the abnormal cells such as those found in cancerous tumors. Histopathology image is also widely used in basic research to understand the distribution and localization of bio-marks and differentially expressed proteins in different parts of a biological tissue. Figure 1 shows that examples of H&E and IHC stained image. H&E staining image is accommodate from UCSB dataset of a benign stage. The histopathological images are acquired through digital camera through a light microscopy with a different magnification such as 10×, 20× and 40×.

3. Proposed Work

This proposed algorithm presented a Histopathological image enhancement using two stage adaptive histogram equalization (TSAHE). Histogram is the basis for numerous spatial domain image processing techniques. In specific, the role of histogram equalization is important in image enhancement. It is sensible to conclude that histopathology images, whose assigns intensity values of pixels in the input image such that the output image contains a uniform distribution of intensities. Let P is the input image and Q is the histogram equalized image. The objective of this algorithm is to initiate an enhanced image, which has provide a better visual quality compared to original image P. This algorithm enhances the contrast of an image based on AHE by mapping the pixel values in such a way that the histogram of the resulting image becomes uniform.

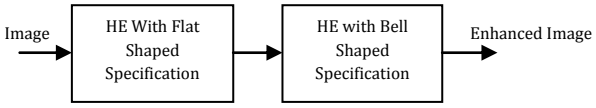

Fig -2: Proposed Two Stage Adaptive Histogram (TSAHE) Equalization

Flat and bell shaped histogram are used to achieve a desired histogram from an image tiles. Flat specification which indicates that exactly the same thing is happening over and over again. Bell shaped specification usually represents a normal distribution. This type specification usually appears to have one cluster that much of data cluster around. In Principle, there are two stages in our proposed AHE approach (i.e.) two consecutive stages with desired histograms. The proposed method is improved and Evidenced from the color information of original, AHE and proposed TSAHE. More specifically proposed method gives better results compared to standard adaptive histogram equalization (AHE).

4. Experimental Results and Discussions

The proposed method is tested on all histopathological images from UCSB and pathpedia database [8]. In order to prove its qualitative efficiency, three of the results are presented in Fig. 3. First column of Fig. 3 refers the original, second column refers to the output of contrast limited AHE (CLAHE) and third column refers to the output proposed TSAHE method. From the presented results it is easily observed that our method TSAHE enhances the contrast of the histopathology image in better way than CLAHE.

The enhancement results are evaluated using Entropy, Measure of Enhancement (EME).

Entropy

The image enhancement is based on information content of an Image. Larger entropy value the image has, the higher information contained in the output image. The entropy for the whole image can be defined by,

$$H(K)= \sum_{i=0}^{255} p_i \log_2 p_i$$

Where, p_i is the probability of intensity I at pixel in enhanced Image.

Measure of Enhancement (EME)

Measure the values at given pixel for enhanced image should be depend on the pixel.

$$EME= \frac{1}{K1K2}\sum_{M=1}^{k1}\sum_{l=j}^{K2} 20\ ln\ \frac{I\,l,m}{I\,l,m}$$

Where the image (I) spilt into K1, K2 blocks, I l,m max and I l,m min maximum and minimum values of pixels in every block of the enhanced image.

Table -1: Performance Comparison Proposed and Other Enhancement Methods

Parameter	original	HE	AHE	CLAHE	TSAHE
Entropy	6.6903	5.7886	7.4803	7.1561	7.8795
EME	11.6324	38.3928	25.9243	21.7027	40.8261

These parameters are evaluated for 10 images in UCSB and Pathpedia database and the average is tabulated in table 1.Proposed techniques (TASHE) gives better results compared to other than methods and analyze the performance qualitatively. The proposed TASHE low contrast enhancement scheme gives high measure of enhancement values and also retains the entropy values from existing methods.

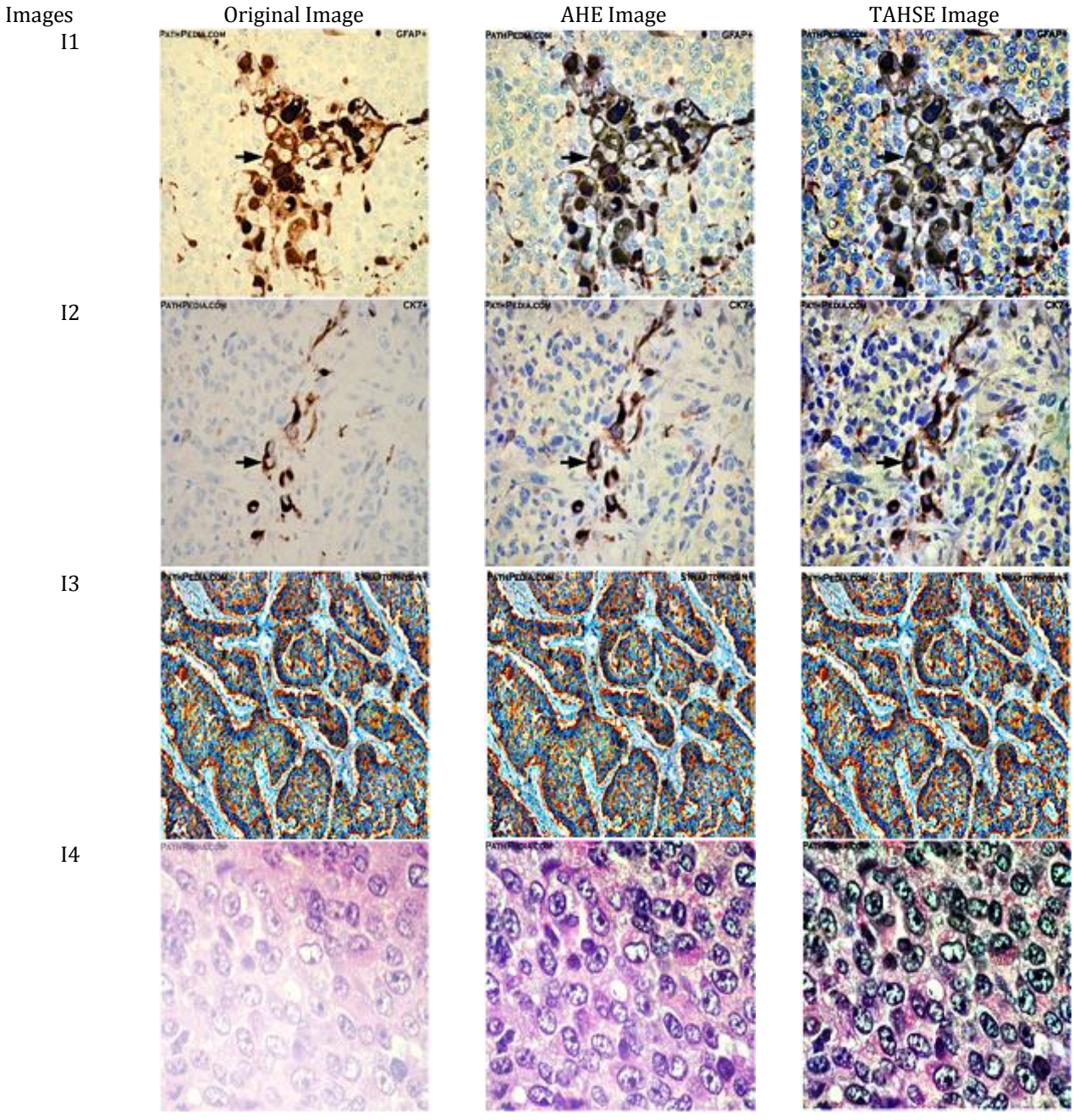

Fig. 3. Enhancement results comparison: column 1: original, column 2: CLAHE, column 3: proposed method TSAHE.

Proposed techniques (TASHE) gives better results compared to other than methods and analyze the performance qualitatively. The proposed TASHE low contrast enhancement scheme gives high measure of enhancement values and also retains the entropy values from existing methods.

Conclusion

Histopathological image enhancement algorithm for restoring the visibility and color contrast appearance of histopathology images with less computational complexity. The novelty of the proposed method is that color image enhancement is based on TSAHE which is a new way to integrate color and brightness information extracted from color image enhancement. The proposed technique offers good performance in terms of better contrast verified by improved Measure of enhancement (EME) and the information content in the image is verified by comparing entropy values of original image and enhanced output image. The experimental results were illustrating the superiority of the proposed scheme over the other methods.

References

[1] Anand S and Gokula Janani., "Analysis of Enhancement Algorithms for Non-uniform Illumination Images," International journal of Applied Engineering Research, vol. 10, pp. 378-383, 2015.

[2] Anand S, ShanthaSelvaKumari R, and Thivya T., "Sharpening enhancement of ultrasound images using contourlet transform," Optik - International Journal for Light and Electron Optics, vol. 124, pp. 4789-4792, 2013.

[3] Anand S and ShanthaSelvaKumari R., "Sharpening enhancement of Computed Tomography (CT) images using Hyperbolic Secant Square filter," Optik - International Journal for Light and Electron Optics, vol. 124, pp. 2121-2124, 2013.

[4] Anand S, ShanthaSelvaKumari R, Jeeva, Thivya "Directionlet transform based sharpening and enhancement of mammographic X-ray images," Biomedical signal Processing and Control, vol. 8, pp. 391-399, 2013.

[5] Anand S, ShanthaSelvaKumari R, Jeeva, Thivya., "Contourlet Transform based Sharpening Enhancement of Retinal Images and Vessal Extraction Application," International Journal on Biomedical Engineering (BMT), vol. 58, pp. 87-96, 2013.

[6] Murugachandravel J and Anand S., "Wavelet Based Image Enhancement using Two Stage Adaptive Histogram Equalization," International Journal of Pure and Applied Mathematics vol. 118, pp. 539-542, 2018.

[7] Anand S and Gayathri., "Mammogram image enhancement by two-stage adaptive histogram equalization" Optik - International Journal for Light and Electron Optics, vol. 126, pp. 3150-3152, 2015.

[8] Jain K, "Fundamentals of Digital Image Processing", Englewood Cliffs, NJ: Prentice-Hall, 1991.

[9] Gurcan M. N. and Bulent Yener., "Histopathological Image Analysis: A review," IEEE reviews on Biomedical Engineering, vol. 2, pp.147-141, 2009

[10] Kim Y. T., "Contrast Enhancement using Brightness preserving Bi-Histogram equalization," IEEE Trans. On Consumer Electronics, vol. 43, no. 1, pp. 1-8, 1997.

[11] Weeks A. R. and Sartor L. J., "Histogram specification of 24 bit color images in the color difference (cy) color space," journal of electronic imaging, vol. 8, no. 3, pp. 290-300, 1999.

[12] Tian Y. and Tan. "Do singular values contains adequate information for face recognition," pattern recognition, vol. 36, no. 3, pp. 649-655, 2003.

[13] Ibrahim H., and Kong "Brightness Protecting Dynamic Histogram Equalization for Image Enhancement," IEEE Transactions on Consumer Electronics, Vol. 53, no. 4, pp. 1752-1758, 2007.

[14] Ledley R. S. and Buas M., "Fundamentals of true color image processing," Proc. 10th IEEE Conf. on pattern recognition, Los Alamos, CA, USA, 1990.

[15] Kuang-Tsu Shih and Homer H. Chen., "Exploiting Perceptual Anchoring for color image enhancement." IEEE Transactions on Multimedia, vol. 18, no. 2, pp. 300-310, 2015.