히스토그램 평형 기법을 이용한 자기 공명 두뇌 영상 콘트라스트 향상

Zahid Ullah[O], 이수현[*]
[O*]Department of Computer Engineering Changwon National University
email: zeeuom@gmail.com[O], sleepl@changwon.ac.kr[*]

Magnetic Resonance Brain Image Contrast Enhancement Using Histogram Equalization Techniques

Zahid Ullah[O], Su-Hyun Lee[*]
[O*]Department of Computer Engineering Changwon National University

● 요 약 ●

Histogram equalization is extensively used for image contrast enhancement in various applications due to its effectiveness and its modest functions. In image research, image enhancement is one of the most significant and arduous technique. The image enhancement aim is to improve the visual appearance of an image. Different kinds of images such as satellite images, medical images, aerial images are affected from noise and poor contrast. So it is important to remove the noise and improve the contrast of the image. Therefore, for this purpose, we apply a median filter on MR image as the median filter remove the noise and preserve the edges effectively. After applying median filter on MR image we have used intensity transformation function on the filtered image to increase the contrast of the image. Than applied the histogram equalization (HE) technique on the filtered image. The simple histogram equalization technique over enhances the brightness of the image due to which the important information can be lost. Therefore, adaptive histogram equalization (AHE) and contrast limited histogram equalization (CLAHE) techniques are used to enhance the image without losing any information.

키워드: MRI, Histogram equalization, image enhancement, median filter, AHE, CLAHE.

I. INTRODUCTION

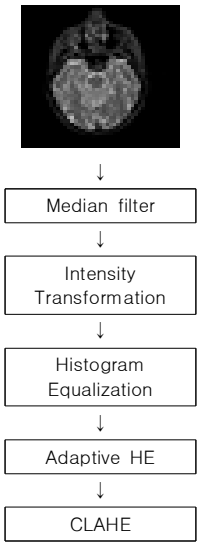
MRI provides the internal information of human soft tissues such as human brain and other body parts. The MR imaging modality is useful for physicians especially when treating foot, ankle and brain tumor. MRI generates Proton Density, T1, and T2 weighted images [1]. For proper diagnosis and prognosis the physicians needs some improved images. In digital image processing and analysis, enhancement is the most fundamental task. The aim of image enhancement is to enhance the visualization of image for human perception.

Histogram equalization is the most renowned technique for image contrast enhancement. The performance of HE technique is astounding for natural images. The most valuable application of HE includes radar image processing and medical images [2]. The HE changes the density distribution to a flat shape of the output image and as a result improves the contrast of the image. In this paper, we have taken MR image as an input and applied different HE techniques to improve the contrast of the image and also consider the histogram of the respective technique.

The rest of the paper is sorted as Section 2 presents the Methodology, section 3 presents the Results and Discussions, while the final step presents Conclusion.

II. Methodology

Our methodology consists of median filter, intensity transformation, and histogram equalization techniques such HE, AHE and CLAHE to improve the contrast of the MR brain image as illustrated in fig. 1. The detail description of each stage is provided in the subsequent sections.



1. Median Filter

The median filter is used in the pre-processing stage to the MR brain image for the removal of salt and pepper noise. As the MR image consist of salt and pepper and rician noises. The median filter removes the noises from MR images effectively while preserves the edges of the image efficiently. The median filter is a non-linear filter and this filter proceed in such a way where it considers every pixel by the median value of neighboring pixel [3]. We have used a 3 x 3 window size for image filtering, as this window size is a suitable window size to filter an image.

2. Intensity Transformation

In the second stage of the proposed method, we have used the intensity transformation function using the imadjust function in Matlab to expand the value of higher pixel while compressing the value of dark pixels [4].

3. Histogram Equalization

The mapping or transformation of every pixel of the input image into corresponding pixels of processed output image is called HE [4]. The function of HE is to adjust the image intensities to improve the image contrast. The equation of HE is as follows:

$$Pn= \quad (1)$$

The range of the MR gray level image is [0… L-1].

4. Adaptive Histogram Equalization

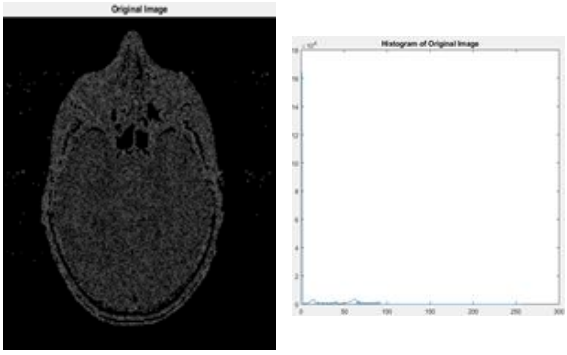
In the fourth stage of the proposed methodology, we have used adaptive HE, as this technique is effective for medical images to enhance the contrast of the image. AHE does not apply transformation or mapping on the overall image, but it performs separately on the sub image and then combine the image in a proper way.

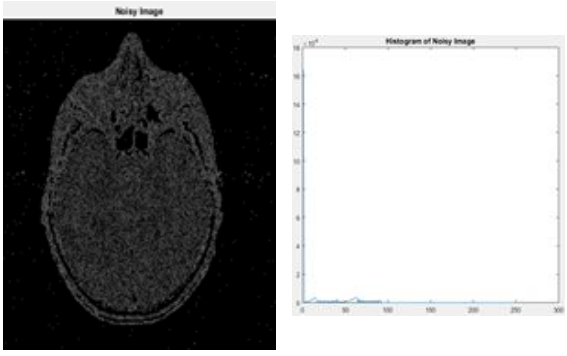
5. Contrast Limited Adaptive Histogram Equalization

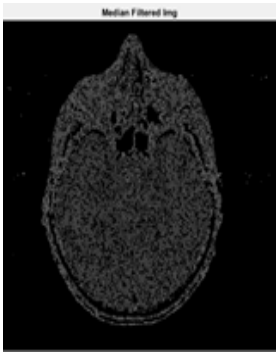
CLAHE is used to control the noise problem which is existed in traditional HE. In the MRI image CLAHE works on the small regions which is known as tiles and it also calculates different histograms, and then compare each histogram to a specific part of the image and furthermore, it is utilize to reorganize the contrast estimation or brightness of the image. CLAHE provides more details as compare to standard HE as CLAHE improve the contrast of the image effectively but CLAHE still has inclination to amplify unwanted pixels which has to be improved in the future work.

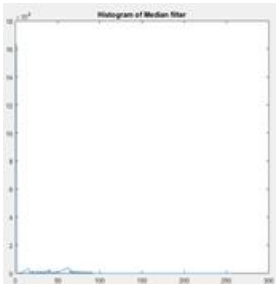
III. Results and Discussions

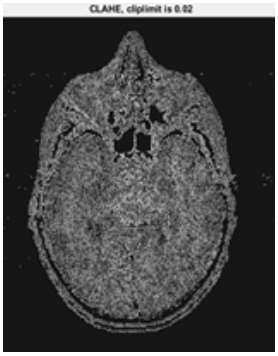
The experimental results are performed using matlab R2015a. Using different HE techniques, MR brain image is enhanced and has shown with the histogram of the resultant image.

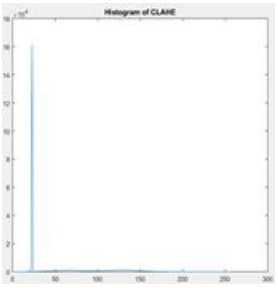


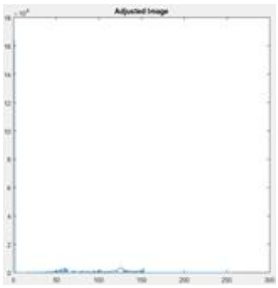


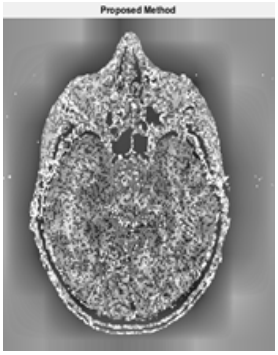


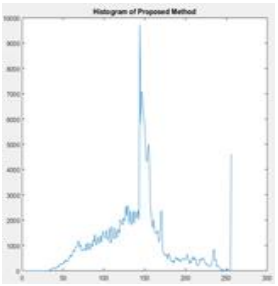


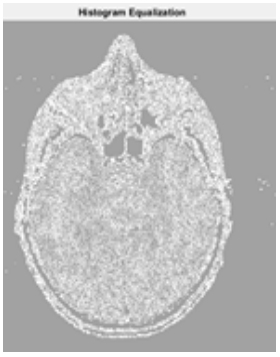


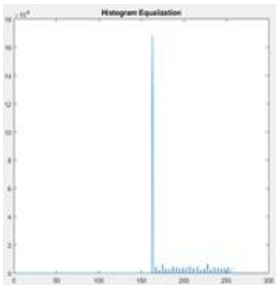


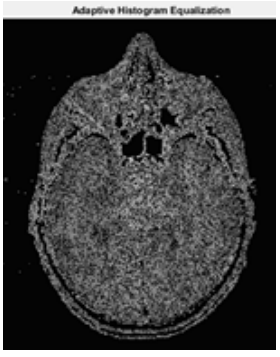


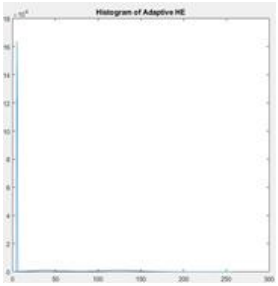












IV. Conclusion

In this paper, we have used different histogram equalization techniques to enhance the contrast of MR brain image. The performance of the proposed method is astounding which is illustrated in the image with the respective histogram.

REFERENCES

[1] Rajesh C. Patil, Dr. A. S. Bhalchandra," Brain Tumour Extraction from MRI Images Using MATLAB", International Journal of Electronics, Communication & Soft Computing Science and Engineering ISSN: 2277-9477, Volume 2, Issue 1.

[2] J. Zimmerman, S. Pizer, E. Staab, E. Perry, W. McCartney, and B. Brenton, "Evaluation of the effectiveness of adaptive histogram equalization for contrast enhancement", IEEE Tans. On Medical imaging, pp.304-312, Dec. 1988.

[3] Y. Wang, Jiangyun Wang, Xiao Song and Liang Han,

"An Efficient Adaptive Fuzzy Switching Weighted Mean Filter for Salt and Pepper Noise Removal", IEEE Signal Processing Letters, pp. 1582-1586, 2016.

[4] Gonzalez, Rafael C. "Digital image processing: Pearson education india." (2009).