International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435(Online) Volume 9, Issue 10, October 2020)

Image Enhancement Techniques in Medical Domain: A Survey

Narendra Dhakad[1], Rajeev Kumar Singh[2]
[1,2]*MITS, Gwalior(M. P.), India*

***Abstract*-- Though this paper, exhaustive review have been performed and analyzed on image enhancement techniques which are applicable in field of medical domain. Image Enhancement is one of the most important and complex techniques in image processing technology. The main aim of image enhancement is to improve the visual appearance on an image and to offer a better representation of the image for Computer Vision Algorithms. Because the quality image play the important role for the finding accurate and precision results in the application domain. Through the comparative table, methods and techniques will be compared on the basis of their accuracy.**

***Keywords*-- image enhancement techniques, accuracy parameters, type of dataset used**

I. INTRODUCTION

In day-to-day life, the scope for improvement in technology is necessary for providing better service to mankind. It becomes difficult to diagnose patients due to low quality of the diagnostic images in certain complex procedure of imaging that provides wrong information. The number of deaths by wrong diagnosis is increasing every year according to latest surveys published in reputed journals. Medical Imaging is an advanced technology to diagnose various parts of human body. Generally, while processing, the images obtained by using various equipments undergo distortion, and the noise will be added up thereby degrading the image quality. Hence, it becomes difficult to analyze the patient's criticality thereby leading to requirement for enhancement of images. The various medical imaging techniques for analysis of human parts are Computed Tomography (CT) [1], Magnetic Resonance Imaging (MRI) [2], Positron Emission Tomography (PET) [3], X-ray [4], etc. The low contrast is the main problem in medical images, which deteriorates the image quality, and image enhancement of such images is must for proper diagnosis. The previous works of enhancement techniques were based on deblurring, filtering, and sharpening the image features such as edges, boundaries, or contrast to make image suitable for better analysis and enhancing the luminance component, which only increases brightness of the image. The gray image enhancement techniques mainly include conventional methods like Histogram equalization (HE) [5], Local Histogram Equalization (LHE) [6] , and Global Histogram equalization (GHE) [6] .

However, the main limitations of these techniques are unpleasant visual artifacts such as over enhancement, level saturation, and raised noise level. To overcome these, techniques like Brightness Preserving Bi-histogram Equalization (BBHE) [5] and Dualistic Sub-image Histogram Equalization (DSIHE) [5] were suggested, which failed to remove the impulse noise In the proposed work, enhancement of both color and gray medical image has been performed. The color image enhancement involves the application of Adaptive Histogram Equalization (AHE) [7] technique to Saturation (S) and Value (V) components; Contrast Stretching technique is applied to improve the overall dynamic range of the images and further luminance component V is enhanced using adaptive saturation feedback. In gray image enhancement technique, sharpening of the edges is obtained using Laplacian filter followed by AHE that overcomes the drawbacks of the conventional methods. In recent years, the growing trend is to record the patient's data for medical documentation and research analysis.

II. RELATED WORK

In paper [4], Target issue was breast cancer which is one of the foremost reasons for the increase in mortality among women. Micro calcifications in breast tissue are one of the key indications appraised by the radiologist for identification of breast cancer in its early stage. To identifying such micro calcification masses and architectural distortion in breast preprocessing in mammogram plays a vital role. The contrast-limited adaptive histogram equalization (CLAHE) and histogram equalization (HE) enhancement approaches were examined on mammogram pictures. The percentage of the most contrasted pixels was determined using the proposed system. It is being observed that the assessment of clinical mammograms may produce a better potential.

In the paper [8], Color funds image analysis was investigated for detecting the retinal abnormalities requires an improved visualization of image attributes with sufficient luminosity, contrast and accurate edge details. The superior results obtained irrespective of the dataset and original image quality signify the high reproducibility of the method, thus can be considered reliable for clinical analysis and pathological diagnosis by ophthalmologists as well as computer aided diagnosis.

In the paper [9], Author suggested to perform a systematic review and met analysis of the most commonly used examinations for recto sigmoid lesions of deeply infiltrating endometriosis, trans vaginal sonography (TVS) and magnetic resonance imaging (MRI), to compare their diagnostic accuracy and enhanced or non-enhanced techniques. Both TVS and MRI showed high diagnostic accuracy for recto sigmoid deeply infiltrating endometriosis lesions. There is no strong evidence suggesting that the two diagnostic methods might differ in specificity or sensitivity, but enhanced techniques may increase the accuracy measures.

Accordingly this paper [10], enhancement of pathological microscopic image (PMI) is a crucial step to increase the efficiency of computer assisted software. Some of the previous PMI enhancement methods neglected the illumination information and others used a reference image for template matching. These methods worked under strictly controlled conditions. In this paper, a robust technique is proposed for pathological images enhancement based on neutroscopic similarity score scaling. This paper presents a comparative study of different pathology image enhancement techniques. It appears to be a novel and efficient technique for brightness, contrast, and color appearance enhancement to utilize NSS in pathology color images enhancement. Our proposed method does not depend on other standard color space transformation like CIE-lab or enhancing a single IQ parameter with neglecting the others. The proposed enhanced image does not contain any background distortion.

Author observed in paper [11], the efficacy of distal tibial tuberosity high tibial osteotomy in treating medial compartment osteoarthritis of the knee.

In the experiment, a medical image enhancement algorithm based on shear wave domain improved Gamma correction was implemented to process medical images in order to diagnose patients more effectively. The results of the retrospective study showed that distal tibial tuberosity high tibial osteotomy could effectively adjust the force line and relieve symptoms, and It is recommended for genuvarum patients with medial compartment osteoarthritis of the knee. The diagnostic images processed by the medical image enhancement algorithm based on the shear wave domain improved Gamma correction can effectively preserve the image details, which is beneficial to diagnosis and improve diagnostic accuracy, helping us to assess patients more accurately before surgery.

In paper [12], The classification of brain magnetic resonance imaging (MRI) images into normal and abnormal classes, has great potential to reduce the radiologists workload. Statistical analysis based approaches has been widely employed for this purpose which are comprised of four stages such as pre-processing, feature extraction, feature reduction and classification. The outcomes of such approaches are highly dependent upon the image quality: better the image, higher the outcome. This paper proposed a medical decision support system using malignant and benignant classes. This system is designed by median filter, CLAHE, wavelet transform, color moments and feed-forward NN. The propose system provide astounding results in categorizing the malignant and benignant MRI images. Considering this methodology, the physician can make the final decision without any hesitation which is the main advantage of this system.

International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435(Online) Volume 9, Issue 10, October 2020)

Table 1:
Comparison between different Image Enhancement Techniques

Paper	Method	Techniques applied	Data Set used	Selected Accuracy Parameter	Accuracy Achieved
[13]	K means & FCM	Histogram equalization Contrast Limited Adaptive histogram equalization	SSRBC2015	Precision	0.50
				Recall	0.79
[4]	Contrast improvement index (CII) contrast. Especially for dense breast	Mammogrm enhancement Breast segmentation using thresholding	Mammographic Image Analysis Society (MIAS)	Cii idex	0.04
				contrast	0.94
[14]	Adaptive Histogram Equalization	Removing Noise and Contrast Enhancement (RNCE)	MEDPIX	PSNR	40.12
[15]	Scanning Tunneling Microscopy (STM)	speckle contrast	PARTICAL	STM	0.71
[16]	one-stop-shop	CAIPIRINHA GRAPPA	Diagnostic	T2W-MRC T1W-MRC	0.93 0.91
[17]	HIPAA-compliant	enhanced T1 high-resolution isotropic volume excitation	Patient	Hap TP	1.70 2.18
[2]	Raman spectroscopy	coherent anti-Stokes Raman spectroscopy	Metals	NIRF	0.74

III. Conclusion

A quality image means that Image has very informative data regarding the processing and extracting relevant information for dedicated purpose. When we consider the image in the medical domain, then importance of medical image or we can say a high quality image is always high. In this connection, Image enhancement techniques play an important role in this area or any relevant domain. In this paper, exhaustive analyses are performed on image enhancement techniques and compared on the basis accuracy parameters and their results.

REFERENCES

[1] M. Gan et al., "Application of computed tomography (CT) in geologic CO2 utilization and storage research: A critical review," J. Nat. Gas Sci. Eng., vol. 83, no. September, p. 103591, Nov. 2020.

[2] N. Singh, P. Kumar, and U. Riaz, "Applications of near infrared and surface enhanced Raman scattering techniques in tumor imaging: A short review," Spectrochim. Acta Part A Mol. Biomol. Spectrosc., vol. 222, p. 117279, Nov. 2019.

[3] M. Zhang, S. Li, H. Zhang, and H. Xu, "Research progress of 18F labeled small molecule positron emission tomography (PET) imaging agents," Eur. J. Med. Chem., vol. 205, p. 112629, Nov. 2020.

[4] S. Tripathy and T. Swarnkar, "Unified Preprocessing and Enhancement Technique for Mammogram Images," Procedia Comput. Sci., vol. 167, no. 2019, pp. 285–292, 2020.

[5] J. R. Tang and N. A. Mat Isa, "Bi-histogram equalization using modified histogram bins," Appl. Soft Comput., vol. 55, pp. 31–43, Jun. 2017.

[6] Y. Wang and Z. Pan, "Image contrast enhancement using adjacent-blocks-based modification for local histogram equalization," Infrared Phys. Technol., vol. 86, pp. 59–65, Nov. 2017.

[7] I. S. Isa, S. N. Sulaiman, M. Mustapha, and N. K. A. Karim, "Automatic contrast enhancement of brain MR images using Average Intensity Replacement based on Adaptive Histogram Equalization (AIR-AHE)," Biocybern. Biomed. Eng., vol. 37, no. 1, pp. 24–34, 2017.

[8] G. Palanisamy, N. B. Shankar, P. Ponnusamy, and V. P. Gopi, "A hybrid feature preservation technique based on luminosity and edge based contrast enhancement in color fundus images," Biocybern. Biomed. Eng., vol. 40, no. 2, pp. 752–763, Apr. 2020.

[9] A. M. G. Pereira et al., "Can Enhanced Techniques Improve the Diagnostic Accuracy of Transvaginal Sonography and Magnetic Resonance Imaging for Rectosigmoid Endometriosis? A Systematic Review and Meta-analysis," J. Obstet. Gynaecol. Canada, vol. 42, no. 4, pp. 488-499.e4, Apr. 2020.

[10] A. I. Shahin, K. M. Amin, A. A. Sharawi, and Y. Guo, "A novel enhancement technique for pathological microscopic image using neutrosophic similarity score scaling," Optik (Stuttg)., vol. 161, pp. 84–97, May 2018.

[11] X. Tian et al., "Distal tibial tuberosity high tibial osteotomy using an image enhancement technique for orthopedic scans in the treatment of medial compartment knee osteoarthritis," Comput. Methods Programs Biomed., vol. 191, p. 105349, Jul. 2020.

[12] Z. Ullah, M. U. Farooq, S.-H. Lee, and D. An, "A hybrid image enhancement based brain MRI images classification technique," Med. Hypotheses, vol. 143, no. April, p. 109922, Oct. 2020.

[13] A. Mohseni, "A new PDE-based resolution enhancement technique for the analysis of low SNR particle displacement images," Eur. J. Mech. - B/Fluids, vol. 85, pp. 289–311, Jan. 2021.

[14] S. S. Bhairannawar, "Efficient Medical Image Enhancement Technique Using Transform HSV Space and Adaptive Histogram Equalization," in Soft Computing Based Medical Image Analysis, Elsevier, 2018, pp. 51–60.

[15] N. A. Emelianov, P. V. Abakumov, and E. B. Postnikov, "An analogue of the speckle contrast technique for low-conducting features enhancement in scanning tunneling microscopy images of nanocomposites," Results Phys., vol. 13, no. March, p. 102323, Jun. 2019.

[16] L. Guimaraes, A. Babaei Jandaghi, R. Menezes, D. Grant, M. Cattral, and K. S. Jhaveri, "Assessment of biliary anatomy in potential living liver donors: Added value of gadoxetic acid–enhanced T1 MR Cholangiography (MRC) including utilization of controlled aliasing in parallel imaging results in higher acceleration (CAIPIRINHA) technique in co," Magn. Reson. Imaging, vol. 70, no. April, pp. 64–72, Jul. 2020.

[17] N. Kawai et al., "Gadoxetic acid-enhanced dynamic magnetic resonance imaging using optimized integrated combination of compressed sensing and parallel imaging technique," Magn. Reson. Imaging, vol. 57, pp. 111–117, Apr. 2019.