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2022 11th IEEE International Conference on Communication Systems and Network Technologies

CSNT 2022

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Hybrid Approach for Image Enhancement and Corner Detection Framework Using Contrast Enhancement Technique and Edge Preserving Filter

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***Abstract*— Image processing is the new edge of computing. Images are very useful for variety of purposes or to solve real life problems. Image enhancement is the key factor of image processing because it effects the outcome of end result. Here we propose the hybrid technique for image enhancement framework. This hybrid technique combination of contrast enhancement technique and edge preserving filters. Contrast enhancement enhanced the image which is acquisition by the variety of cameras and edge preserving filters locate the boundaries or corner which is present in the image. This hybrid approach applied to some medical images, it also helpful for any other types of images as well. Experimental result calculated in MATLAB 2020.**

Keywords-Medical imaging, Image Enhancement, Histogram Techniques, Adaptive Histogram, Guassian Smoothng Filter

I. INTRODUCTION

Digital image processing has increases rapidly in recent years also get popularity as medical imaging techniques have improved. The most important topic in the realm of image processing is image contrast enhancement, which is a preprocessing step. The fundamental goal of image contrast enhancement is to increase the contrast between the objects and their surroundings. Image Enhancement is widely used in all major areas like medical, satellite imaging, digital photography and underwater image processing as well.[1]

Medical Imaging is a major trending area in the field of digital image processing. In medical imaging some major trends like image enhancement, image segmentation, object detection and many more. Today's traditional healthcare transformed to smart healthcare system due to some advancement of technology and infrastructure. Some kind of medical imaging system always require for accurate prediction and diagnostic purpose.

Very important and first major steps in medical imaging is medical image enhancement. Medical image enhancement enhances the image which is obtained from image acquisition process or any digital camera or any device used in basic healthcare like MRI, PET SCAN.

In medical field radiology is major is very crucial for diagnosing the disease and symptoms. A lot of major advancement in technology has already done in this field for better results, but still some uncertainties and error still persist. The purpose of radiology is different for any kind of disease so image should be very clear to identify the situation and predict the results. A small kind of error also disturb the image and the prediction is not up to the mark [2].

Furthermore, the number of image information, quality, and clarity are critical. To achieve these criteria, researchers offered a variety of image enhancing approaches to increase image perception quality.[2]

Furthermore, the number of image information, quality, and clarity are critical. To achieve these criteria, researchers offered a variety of image enhancing approaches to increase image perception quality.[3] Feature extraction of images is required for diagnosis and research purposes. Edge detection and picture enhancement are critical elements in this process. The major three aspects of the feature extraction method for an image are pixel, local, and global, in which the feature of a visual image is mostly based on pixel value. Detecting an edge, on the other hand, reduces the amount of data and filters the image's meaningless data [4].

This paper organized as section II, related work where previously related work is discussed in image enhancement, Section III, proposed methodology where main algorithms and proposed architecture has discussed, Section IV illustrate the experimental results and discussion, section V finally conclude the conclusion and future work.

II. RELATED WORK

A. Point based enhancement

Digital images always contain very important value which is known as pixels. Some basic operations can be performed on digital images for enhancing the pixel value. This approach commonly known as point-based technique. Some major approaches in point-based approaches are as:

1) Brightness Modification

In this approach some kind of constant should be added in existing image. value of constant should be change according to the image.

For increase the brightness of the image we add some fix or constant value in the image.

$$M(i, j)=N(i, j) +W \quad \text{.....(1)}$$

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For reduction in the brightness we should decrease the pixels of the image by subtracting constant value..

M(I, j)= N(i, j)-W……(2)

2) Contrast Adjustment

This method illustrates to upsurge the contrast of the image by multiplying some constant value of the image.

M(I, j)= N(i, j)*W ……..(3)

3) Image negative or inverse transform

This approach is very useful in particular medical imaging. In several time inverse of the image is very crucial for identifying the diseases. This is a very old technique to enhance the digital image. here the dark and light shade replaced with each other. Inverse of the image obtained by subtracting the original image from 255.

M(i, j)=255 -N(i, j)……..(3)

B. Histogram based techniques

Due to its precision and simplicity, histogram equalization is the furthermost esteemed and extensively used in contrast enhancement. It is accomplished by employing its cumulative density function to normalize the intensity distributions, which increases the contrast of an input image and produces a consequent image with a uniform intensity distribution.[3]

The image histogram is the foundation for many spatial domain processing algorithms. It can be used for picture improvement, compression, and segmentation, as well as providing relevant image statistics. Calculating it in software and even hardware implementations is straightforward. Histogram Equalization (HE) creates an image with equally likely intensity levels over the entire image.[5]

Histogram based approach suffers some illuminating related effects. Various different histogram-based approaches already introduced by various researchers. To address problem of mean shift in the output image, numerous researchers have suggested various global histogram equalization methods in recent years. To manage the brightness present in the image and for contrast increases another novel approach brightness preserving HE approach was discussed. 6]

Wang et al. suggested a similar technique called dualistic sub image histogram equalization (DSIHE), this approach is based on median value which is segmented [7], [8]. According to experimental results, DSIHE outperforms BBHE in terms of brightness preservation and entropy. Recursive mean separate histogram equalization (RMSHE) and recursive sub image histogram equalization (RSIHE) were proposed to solve the problem of unwanted side effects.[9][10]

Both strategies are recursive algorithms based on the BBHE and DSIHE techniques. Then, to improve image contrast, researchers look at a novel approach called recursively separated weighted histogram equalization (RSWHE). This method is identical to RMSHE and RSIHE, with the exception that RSWHE uses a normalized power law function [11]. These three HE methods (RSIHE, RMSHE, and RSWHE) provide high contrast enhancement and reasonable brightness retention, however the final image has an over enhancement problem.

To address these flaws, a group of authors proposed adaptive gamma correction with weighted distribution (AGCWD), a novel automatic transformation technique. With the help of Gama Correction approach changing the value of probability distribution in pixels of the image, this technique raises the brightness level of a low contrast image.[12]

Another study uses a combination of bi-level weighted histogram equalisation and adaptive gamma correction to achieve good brightness retention and contrast enhancement, although this method introduces the issue of uneven illumination [13].

As a result, these new discoveries look at another effective AGC-based method for striking a compromise between excellent enhancement and low computational cost. The range limited bi-histogram equalisation (RLBHE) and AGC techniques are combined in this method [14]. In comparison to RLBHE and adaptive gamma correction with weighted distribution, this suggested method more better for enhancement for lesser contrast images, according to experimental data (AGCWD).

TABLE I LITERATURE SUMMARY

Author Name and Year	Approach	Performance	Remarks
Y.T. Kim (1997)[6]	Bi Histogram technique based on histogram preserving	Resulting images and corresponding histograms	It looks like over enhance image
Y. Wang, Q. Chen, B.M. Zhang (1999)[7]	Similar to Bi histogram based approach but division is median basis	Mean ,entropy and other relevant images	Also over enhance but preserves mean
S.D. Chen, A.R. (2003)[9]	Recursive segmentation based approach	Improved images	Resolves the over enhancing problem and also preserve brightness
K.S. Sim, C.P. Tso, Y.Y. Tan (2007)[10]	Also similar with recursive approach but division is basis on median	PSNR value of image	Preserve more brightened image and enhance quality is good
Kim & Chung (2008)[11]	It is also similar with earlier approaches but it has weighting process	PSNR and entropy level	Preserve brightness, also produced good contrast value
S. Haung, F. Cheng, Y. Chiu (2013)[12]	Adaptive Gama Correction method	Useful for colour images	Very less distortion

III. PROPOSED METHODOLOGY

As seen in literature survey some issues still not resolved in earlier approaches, like low light images still not enhance by the existing approaches and we also improve PSNR value. The proposed model works all types of images either colour images or gray scale images. Also enhances the low light images very efficiently. In proposed methodology we proposed hybrid approach for image enhancement and introduce model for edge or corner detection.

A. Adaptive Histogram Based Approach (AHE)

This is the very popular algorithm for image enhancement. After capturing the image, it contains several types of noise in image. Various histogram-based approaches are already introduced by the researchers.

AHE is the variation in histogram-based approach. In histogram-based techniques some issues arise like we cannot manage the contrast of the image. after enhancement, resulting images diminished contrast as compare with the original image.

Adaptive histogram-based approach also known as CLAHE, where we limit contrast in the original image. Adaptive histogram-based technique deals in small regions, where normal histogram-based approach works on the entire image. Adaptive nature of the algorithm is very useful in all types of images like medical images and many more.

AHE approach uses the image in small regions or tiles, and later on all regions combined together to get the resultant image. Here bilinear interpolation is used to eliminate the boundaries which is induced in the resultant image. In AHE the noise present in the image is also get more contrast to avoid this situation we use CLAHE to avoid noise amplification which is get more enhance in the image enhancement process.

Steps are as follows:

Step 1: Load the image

Step 2: Apply histogram function to the original image.

Step 3: Generate histogram and enhance image using existing library

Step 4: Get the resultant image

B. Edge Detection

This is the another very interesting approach which is used In edge or corner detection. In image enhancement, after the enhancement process edges may be blur or difficult to separate the images with each other. This hybrid approach also useful for the detection purposes. After the enhancement process edges may blur or difficult to separate the objects or difficult to locate boundaries among in image. Here image gradient is used to highlight the corners or boundaries.

Step 1: Load the original image

Step 2: convert the image into gray scale image if required

Step 3: Add some noise like gaussian noise in the image

Step 4: Now compute the gradient magnitude of the image using sobel.

Step 5: Sobel 3*3 magnitude filter is used

Step 6: After appliying Sobel or any operator like Prewit image still noisy.

Step 7: Apply Guassian smoothing filter for noise removal process.

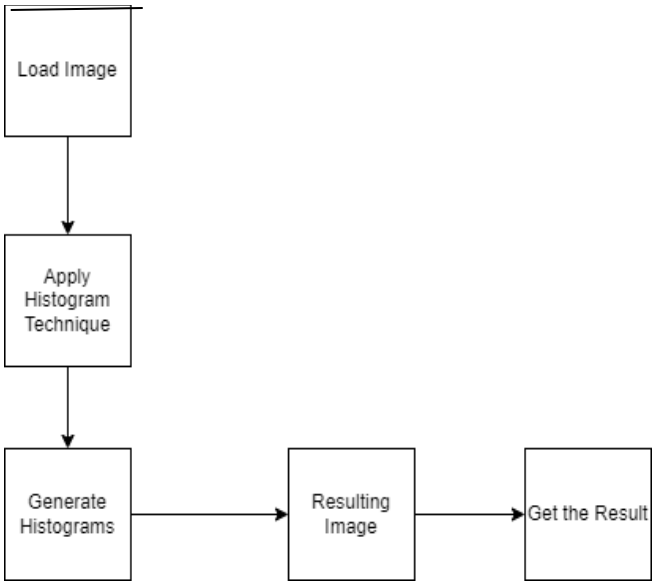

Figure: 1 Image Enhancement Model

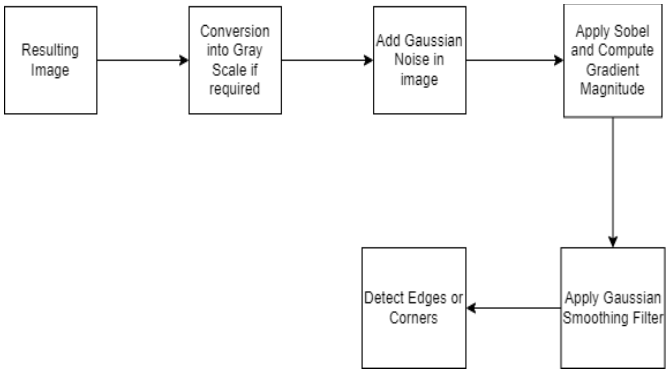

Figure: 2 Edge detection Model

IV. EXPERIMENTAL RESULTS ANALYSIS

The model implemented in MATLAB 2020, a very powerful tool for image processing. In MATLAB rich set of library functions are available. There is a separate image processing toolbox available, where we can perform variety of operations over images.

A. Simulation Results

The complete simulation process can perform in MATLAB. The set of images taken from different databases. Some medical images and some ordinary images taken form open-source dataset. Here we can obtain the result on MRI, XRAY images and also some common images. We can get the enhanced images and also compute some parameters like entropy and PSNR. Entropy and PSNR gives the quantitively measure of the image. While enhance image shows the

qualitative results. Both types of results are very important for analysis.

a) Entropy

It is a very important factor for quantify measurement of the image. Entropy shows the intensity level in the image. Higher entropy indicates that the lesser intensity saturation.

b) PSNR (Peak signal to noise ratio)

In enhancement process always retain its original looks it means noise level should not magnify in the enhanced image. PSNR is the ratio of signal power and input power. A higher PSNR indicates the noise level should be eliminated and reconstruction of the image is higher intensity value.

This model have a combination of Image enhancement and Edge detection mechanism which provides uniqueness and some specialty into existing methodologies. Some previous researchers have calculated the entropy and PSNR values for the medical images as well. Some images have some degradation into PSNR values and also maintain the level of entropy. Figure 3 to 6 are images of input and output. Figure 7 showing the histogram of the proposed work.

Figure 3: Orignal Medical Image and Contrast Enhanced Image

Figure 4: Original Image and corner detection in respective image

Figure 5: Original Image and corner detection in respective image

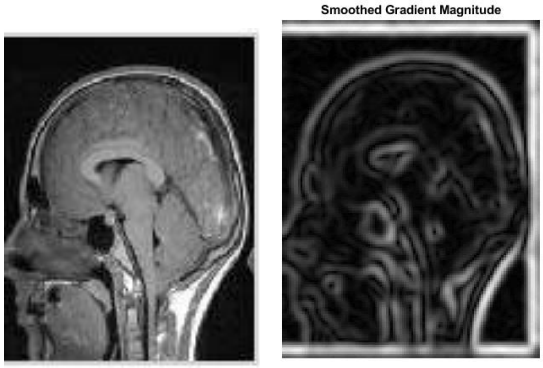

Figure 6: Original Image and corner detection in respective image

TABLE I. ENTROPY CALCULATION IN DIFFERENT IMAGES

Table Head	Entropy	
	Original Image	***Enhance Image Subhead***
Hand	6.8385	5.5852
Skull Image	7.3296	5.8807
Bone XRAY	7.2567	5.7925

(Entropy of different images)

TABLE II. PSNR CALCULATION IN DIFFERENT IMAGES

Table Head	Peak Signal to Noise Ratio (PSNR)	
	Original Image	***Enhance Image Subhead***
Hand	6.8385	5.5852
Skull Image	7.3296	5.8807
Bone XRAY	7.2567	5.7925

(PSNR of different images

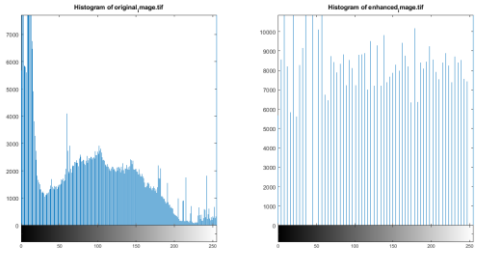

Figure 7: Histogram of the original Image and Contrast Enhanced Image

V. CONCLUSION AND FUTURE SCOPE

In this work we introduce the hybrid approach for image enhancement framework. This approach solves two objectives Image enhancement with high contrast and also compute corners or edges within the images. Here medical images are studied are used for simulation process. This

hybrid approach is very useful in the field of medical image processing where enhancement and edges detection are required. In this work the quantitively measurement is also impressing but still some improvement needed in entropy value. Also introduce new edge of computing like CNN and deep learning model for enhancing the results.

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