International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 09 | Sep 2021 www.irjet.net p-ISSN: 2395-0072

Image Fusion for Enhancement of Low Quality Contrast Images Using Deep learning

Dr. Aravinda H L, Pooja F Puttiyavar

[1]*Dr.Aravinda H L, Associate Professor, Dept. of Electronics and Telecommunication Engineering, Dr Ambedkar Institute of Technology, Karnataka, India.*
[2]*Pooja F Puttiyavar, Student, Dept. of Electronics and Telecommunication Engineering, Dr Ambedkar Institute of Technology, Karnataka, India.*

Abstract - For the role to find and detect images even in low visibility conditions, unmanned aerial objects are equipped with infrared search and tracking systems. However, because sensors are quickly influenced by a variety of situations, most IRST systems require advanced contrast enhancement (CE) methods to cope with the output's low visibility. The images has unwanted effects such as low contrast expansion. We propose the convolutional neural network method for contrast enhancement. We evaluate the proposed method and compare it with conventional CE methods using the peak signal to noise ratio (PSNR) and structural similarity index (SSIM) values. Furthermore, the results of our method have obvious advantages in maintaining the authenticity of colors, textures and information.

Key Words: **Contrast enhancement, Convolutional neural network, Peak signal to noise ratio, Structural similarity index.**

1. INTRODUCTION

Image processing is the process for improving or capturing valuable details from a picture. Image processing systems are becoming more and more popular as powerful personal computers, heavy memory devices, and graphics software become more readily available. Improving image information for human perception and image data processing for activities such as storage, transmission and extraction of pictorial information are the main application areas of image processing technologies. Processing of the Image is a method of enhancing images which are underdone that is obtained originating at board spacecraft, satellite inquest also cameras and sensors at aircraft, as well as images taken for various purposes in daily life. Many attempts and methods has being created within the image processing field over the last four and a half decades.

Picture input and output are the characteristics of an image, a feature, or an image in this type of signal processing. Image processing is one of the fastest growing technologies today. It is also a leading subject in computer science and engineering research.

The image is the collection of all relevant information from numerous pictures and its incorporation into fewer, typically single, images. This one picture has all of the essential information and is more informative and accurate than any single source image. The goal of image processing is not just to decrease data, but also to create pictures that are more suitable and comprehensible to human and machine perception. Multisensory image fusion is a computer vision technique that combines pertinent information from more than two pictures into a single picture.

2. IMPLEMENTATION OF THE SYSTEM

Contrast enhancement is an important part of processing of an image so as to achieve each living being and device image. Image contrast enhancement works by changing the specific image to get a better result than the original. To maximize the usefulness of the graphical presentation of the analysis, it highlights and sharpens the visual features. Optimization does not alter the content of the picture; instead, it enhances contrast with selected image so that it can be easily identified. Processing of the picture or image is the process that treats images to enhance images or to gather useful information from them. The convolution neural network is used in image optimization due to the accurate output image. The use of the convolutional neural network accelerates computation. This will lead to the image being removed by deleting small bits at a time. Convulsive neural network can segregate information. Methods that enhance image contrast include contrast-reduction adaptive histogram equivalence (CLAHE), general histogram equivalence (GHE), and bright binary histogram equivalence (BBHE) preservation. PSNR and SSIM modules are calculated. Poor quality contrast image is enhanced by using higher PSNR values and lower SSIM values.

3. BLOCK DIAGRAM

As a block diagram, the above image depicts the general design of the suggested approach. The picture with low contrast is used as the input image. The HSI picture is created by converting the input color image into hue, saturation, and intensity.

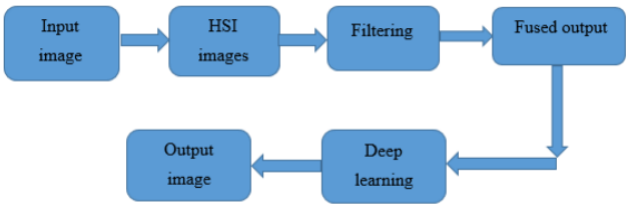


Fig-1: A Conceptual block diagram

3.1 HSI image

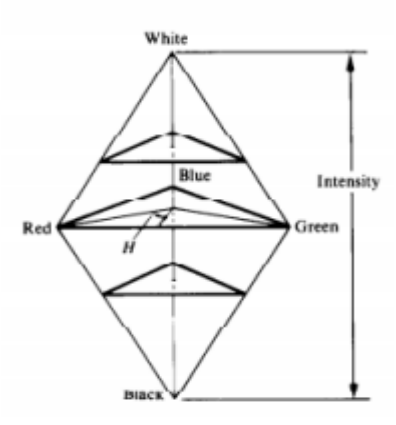


Fig-2: The HSI model

The essential tones are 120 degrees separated. The optional tones are 60 shades more obscure than the essential. A point from a reference point decides the shade of a point. The point from the red hub is utilized as the reference point by show. From the red hub, the tint rises counterclockwise. The length of the vector from the beginning to the fact of the matter is known as immersion. The power hub decides the beginning.
Converting tones from RGB to HIS:-

Hue is given by

$$H = \begin{cases} \theta & if\ B \le G \\ 360 - \theta & if\ B > G \end{cases}$$

θ is given by

$$\theta = \cos^{-1}\left\{ \frac{\frac{1}{2}\left[(R-G)+(R-B)\right]}{\sqrt{(R-G)^2+(R-B)(G-B)}} \right\}$$

Saturation is given by

$$S = 1 - \frac{3}{R+G+B}\min(R,G,B)$$

Intensity component is given by

$$I = \frac{1}{3}(R+G+B)$$

3.2 Filtering

Filtering is the process of selectively eliminating high frequency components from a picture. Components with high in frequency are removed by the help of filter with low pass. Gaussian filters are excellent filters because they have a design that can be adjusted by changing only one variable, sigma. Low pass filtering, as the name implies, is about filtering in such a manner that low frequencies always pass through and are not compressed by the filter; low frequency components correlate to the image's slowly moving parts.

$$G(x,y) = \frac{1}{2\pi\sigma^2}e^{-\frac{x^2+y^2}{2\sigma^2}}$$

3.3 Fused image

The fused image is the combination of white balancing, gamma correction and sharpening, fused appearance of an image too expound like processing of an image and described even as the assembly of significant evidence among all numerous imageries, also of them insertion to the less imageries, normally into solitary unique.

3.4 Convolution neural network

The convolutional neural network is made up of depth, height, and width, where depth represents color (red, green, and blue), height represents pixel values, and width indicates intensity.

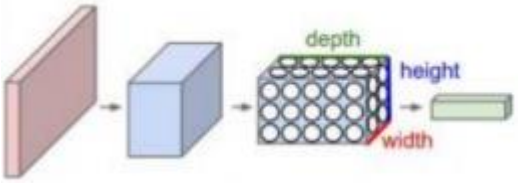


Fig-3:convolution neural network

There are two main elements to a CNN:-Convolutional layer and Pooling layer.

Convolutional layer- A CNN's basic building component is the convolutional layer. The layer's parameters are made up of a kernel that runs the length of the input image's blue green also red networks. Convolution in relation to the kernel also the input is computed by convolving each filter

(kernel) over the pixel of the input. At each pixel, it extracts features

Pooling Layer-In pooling layer the kernel travels across all the pixel of the images. The highest value of the output of convolution between the input and the kernel is the value of pixel in the output imageries. Hence improve image quality.

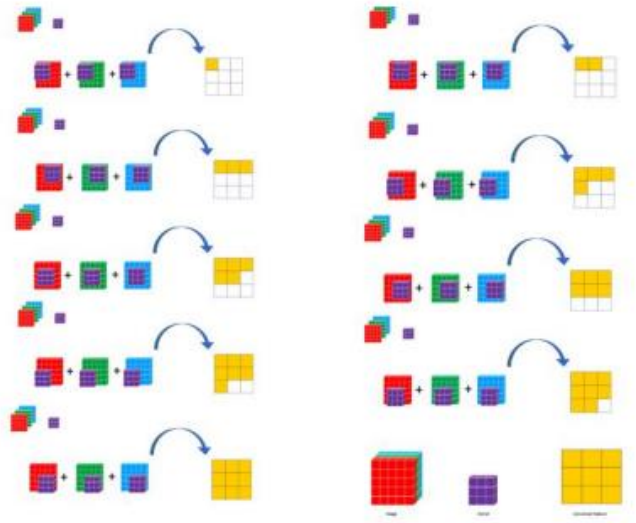


Fig-4: Convolution and pooling layer

This is accomplished via max-pooling, which convolves the maximum value of the window the filter is looking at across the picture. Only computing power and time, as well as the danger of overfitting, restrict the amount of convolutional and pooling layers that may be used in a CNN. After applying the Convolution Neural Network, all blue green also red networks of the kernel is transformed so as get maximum pixel values and better image.

3.5 Contrast histogram equivalence with AHE (Adaptive Histogram Equalization)

Defined as the technology of the processing of the image by computers utilised for increasing contrast between images. Changes the image distribution to change the contrast of the image. As a result, they are excellent for enhancing the image and enhancing the local contrast.

3.6 General Histogram Equalization

Also known as (GHE) is a basic strategy to build the difference of a picture. Straightforward chart data from the information picture is utilized to make a solitary capacity in GHE. It is great to improve the general differentiation of the picture. GHE innovation expands picture contrast, bringing about a more viable picture.

3.7 Binary histogram equivalence (BBHE) with preserved brightness

The BBHE input that segregates the histogram of the picture towards two regions, one from the lowest gray level to the medium, and the other from the medium to the highest gray level. Then it is separately equivalent to a histogram.

3.8 Peak signal to noise ratio and Structural similarity index.

The PSNR and SSIM data utilized in various enhancement techniques are used to analyze the enhancement. The picture visibility improves as the PSNR value increases, but the SSIM value decreases.

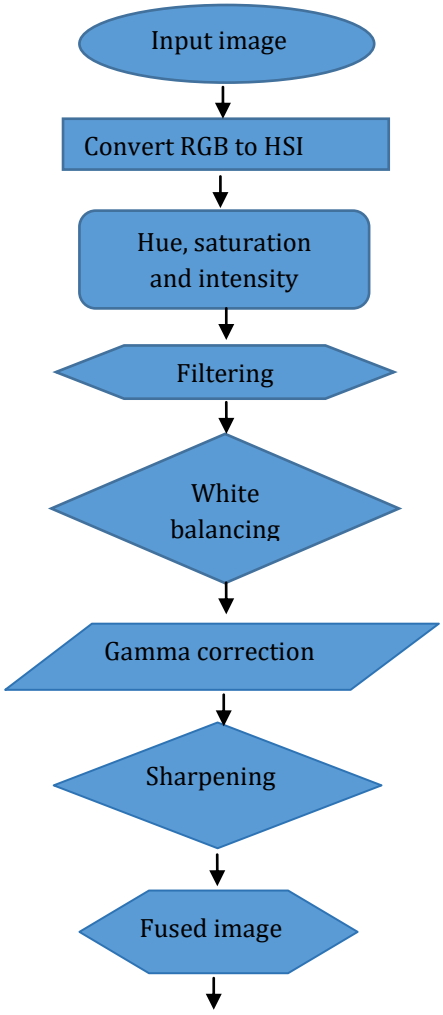
PSNR is represented as:

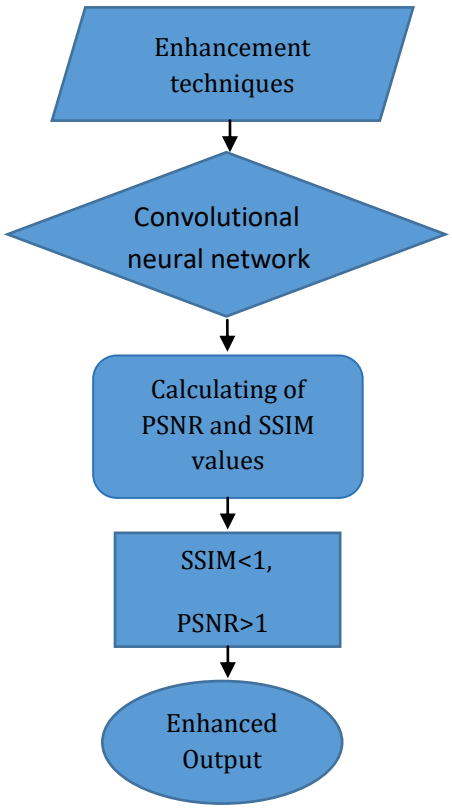
$$PSNR = 20\log_{10}\left(\frac{MAX_f}{\sqrt{MSE}}\right)$$

SSIM is represented as:

$$\mathrm{SSIM}(x,y) = \frac{(2\mu_x\mu_y + c_1)(2\sigma_{xy} + c_2)}{(\mu_x^2 + \mu_y^2 + c_1)(\sigma_x^2 + \sigma_y^2 + c_2)}$$

4. FLOWCHART:-





5. RESULTS AND DISCUSSION

The result shows the proper working of our proposed method, and it can be used for images, which results in the enhancement of the low contrast image hence it accentuates and sharpens image features to make a graphic display more helpful for analysis.

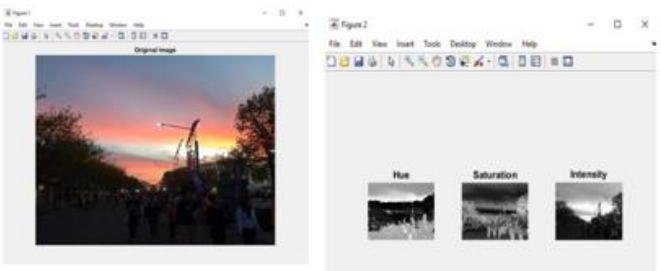


Fig-5: Input image,hue saturation and intensity

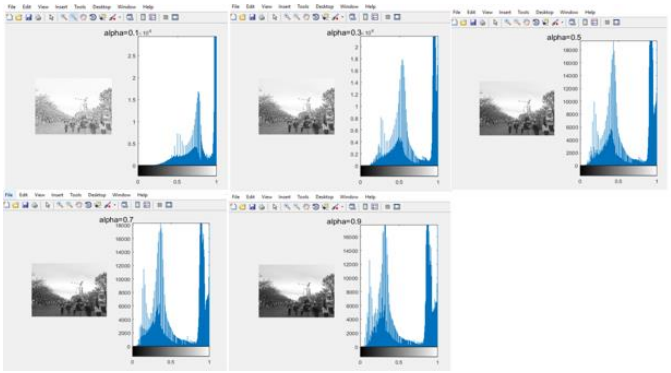


Fig-6:Gaussian distribution at different alpha values

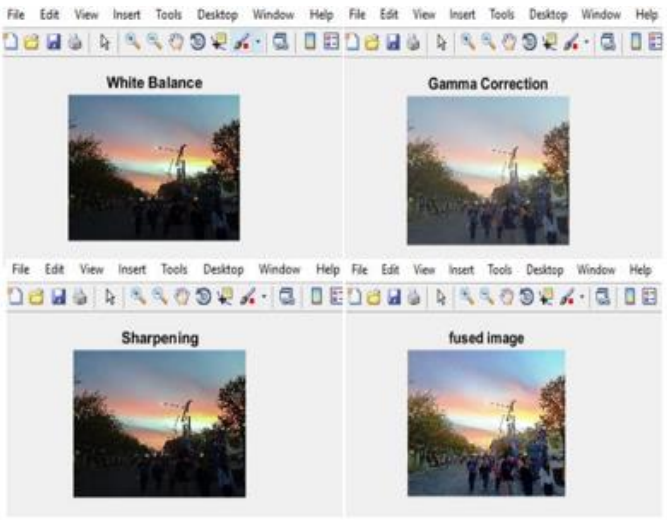


Fig-7: Fused image

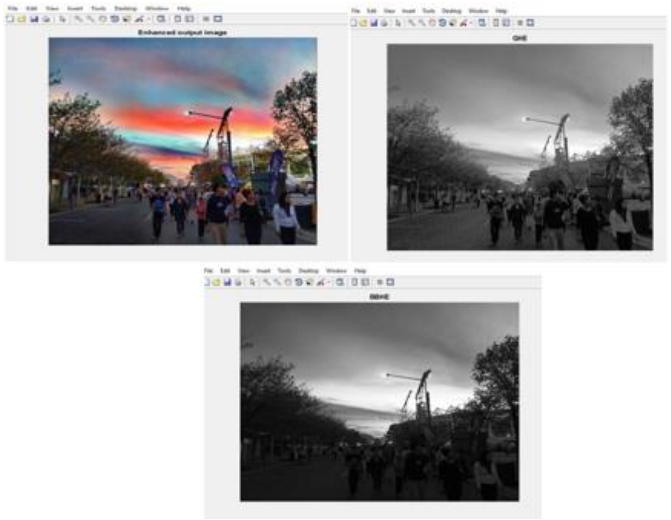


Fig-8: Output image of CLAHE,GHE and BBHE

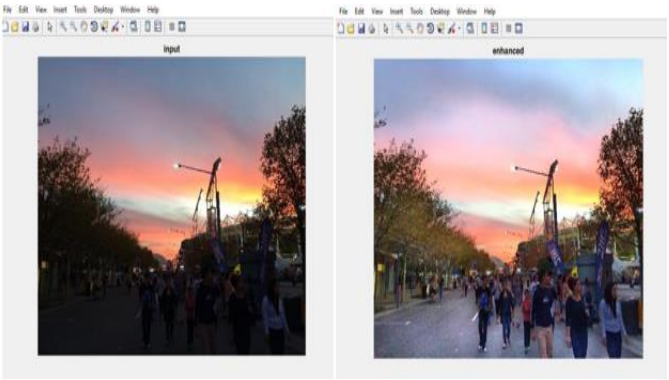


Fig-9:Input and enhanced output image using CNN

The enhancement is analysed based on the PSNR and SSIM values used in different enhancement techniques, higher the PSNR value better the image visible, lower the SSIM values higher the visibility.

Methods	PSNR	SSIM
CLAHE	65.6035	0.227
GHE	28.9134	0.773
BBHE	20.5309	0.959
CNN	72.4514	0.029

Fig-10: Tabular coloum representing PSNR and SSIM values

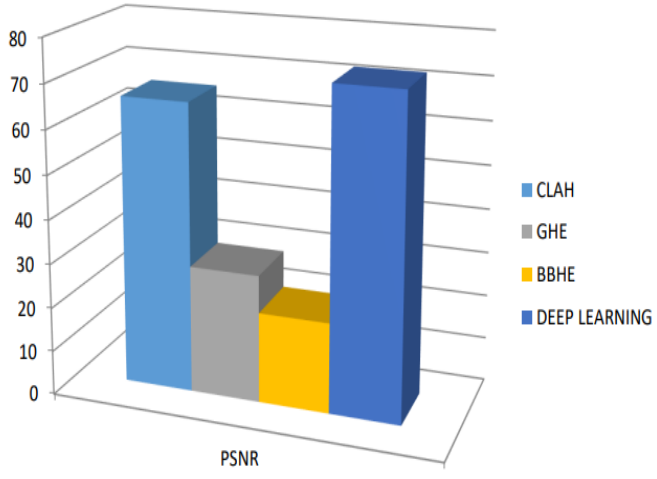


Fig-11: Graphical representation of PSNR values

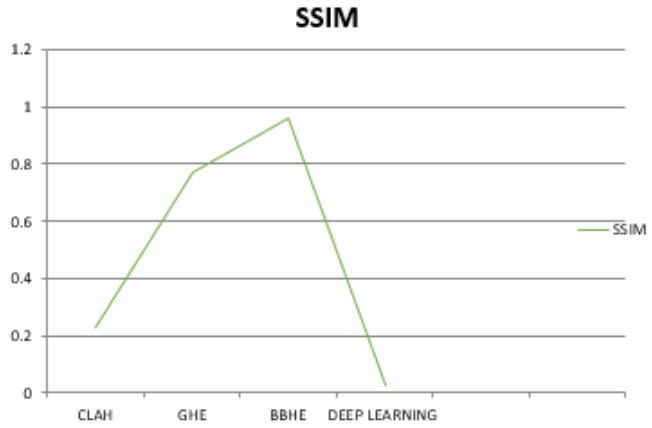


Fig-12: Graphical representation of SSIM values

From the above graphical representation of PSNR and SSIM it is evident that the convolutional neural network has proven better enhanced resultant image when compared to other enhancement techniques.

6. CONCLUSION

The suggested technique has a strong enhancing impact and enables the operation to generate better pictures as a consequence. The picture processing is more efficient and less expensive. High PSNR and low SSIM values result in an enhanced picture. Because of its accurate output picture, the convolutional neural network is utilized in image enhancement. The calculation is greatly sped up with the use of a convolutional neural network. It restores dark pixel values while also lowering noise levels. The suggested technique not only shows the high contrast enhancement effect in black and white saturation at the same time, but it also enables for real-time operation and pictures with low noise levels.

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