ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 5, Special Issue 1, February 2024

Fusion of low contrast image for color image enhancement

Santosh Kumar Jha, Prashant Kumar Jain. Prabhat Patel
UIT RGPV Bhopal

***Abstract-** Low-cost digital cameras typically capture photos that differ from the actual scene's colour and brightness in terms of brightness and colour. Poor-contrast images e caused by a variety of issues, including uneven lighting, over or underexposure of some regions, and unintentional camera user motions. Consequently, approaches for enhancing contrast are necessary to further improve the visual appeal of colour images. The implementation of the wavelet based image Fusion approach is proposed to enhance the image quality in this paper. Initially the contrast difference image is locally generated from the input image using the DC coefficients augmentation approach within the compressed DCT domains. In the second pass scaled contrast image is fused with image under test using the pixel level fusion rules. The absolute average deviation difference is one of the measures used to compare performance alongside SNR and entropy. On a variety of real colour photographs from varied environments, the approaches are tested.*

Key words: **Image enhancement, Image Fusion, Wavelet Transform, Discrete Cosine Transform, DC coefficient Scaling, Entropy, SNR, Mean Brightness**.

I. INTRODUCTION

By mixing images with various exposures or contrast levels, image fusion might be employed for enhancing the poor contrast. There are several ways to accomplish this goal, the most common approaches are represented in the Figure 1. The most common method of fusion is the multi focus image fusion [1, and 2]. The methods of the Feature based image fusion as reviewed in [3 and 4]. A multi modal Image fusion approach [5] is most common in the Medical imaging case where image captured from Multi-modality are fused together. There are many and the most used image fusion approach is using transform domain techniques [6, 7, and 8]. It is since huge numbers of transformation s are available to improve the image quality. There are certain hybrid approaches also which usually combines DCT and DWT. The earlier the method of DC coefficient scaling was proposed [9, 10] but it may have sensitive to over brightness enhancement or suffer from the blocking effect due to DCT too. Thus it is required to highly improve the performance of these methods. In recent times various optimizations have been incorporated for contrast improvement process too.

This paper has proposed to use the combo of the image fusion and the DC coefficient augmentation approach for single image enhancing. Approach is capable of improving the contrast preserving brightness and removing blocking effects too. For true colour images, this study contrasted the conventional DC coefficient scaling approach in the Y-Cb-Cr colour space to the DC coefficient scaling in the CIE-Lab colour space.

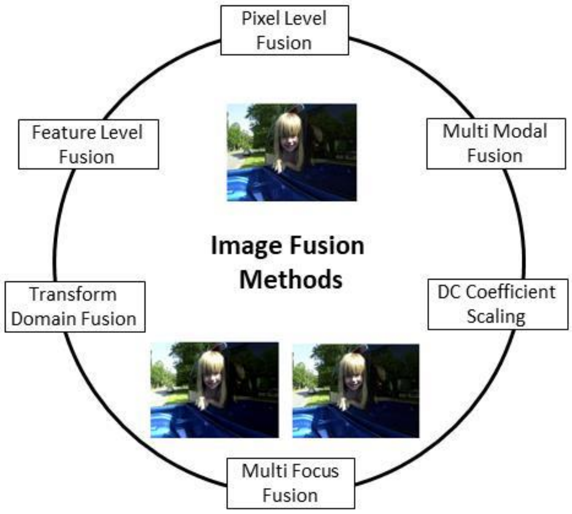


Fig.1 Classification of the Image Fusion Methods

The particular application determines the best fusion technique. Pixel-level fusion, for instance, is frequently employed for straightforward contrast enhancement responsibilities, but feature-level fusing or transformation based fusing can also be utilized for more challenging applications. A potent technique that may constitute used for increasing the visibility of features in photographs is image fusion during contrast enhancement. It is a flexible approach that may be applied to a wide range of applications, including machine vision, remote sensing, and medical imaging. In the rest of the paper after introducing the concept in the section 2 various existing research are reviewed in the field of contrast enhancement also based on the various used color spaces. In section 3basic wavelet based image fusion approach s described. The proposed methodology of the hybrid transformation domain fusion approach is preseted in the section 4. The method using the DC coefficient scaling is also described in the section. Section 5preseted the result of proposed fusion based contrast enhancement and the parametric study to justify the efficiency. Section 6 finally presets the conclusions and scope of future.

II. LITERATURE REVIEW

Several approaches for picture improvement are proposed in the literature, including methods based on the image histogram, regional focused enhancement, and transform field methods. There is lot of fusion based methods most common is multi focused fusion. He L et al

[1] proposed fusion of images utilized for many fields viz. transportation, medical, and surveillance As a solution to fusion problem this paper proposes an effective multi-focus picture fusion method.

Çakıroglu, F et al [2] have compared various optimizations as Swarm Optimization (PSO), Bee Colony (ABC), and Jellyfish Search (JSA) they proposed to combine physics-based techniques, the ABC and JSA methods. Furthermore, algorithms according to meta-heuristics are more versatile in general than traditional fusing procedures. Kaur et al [3] discusses numerous fusion techniques on different levels, along with their benefits and drawbacks, as well as many geographic and transform-based techniques with quality measures and their uses in many fields. They have reviewed finished with a number of future possibilities regarding different fusion of images uses. Li L et al [4] proposes a unique shear let transform regional energy with limited representation multi-focus picture fusion technique. The shear let transform is used to decompose the source pictures into disadvantaged and high-energy sub-bands. The high-energy segments are fused via local energy while the LL bands are merged by patchy depiction. Performance is tested on the Lytro the data set, which contains 20 pairings of images, is employed.

Saleh et al [5] have proposed multi model fusion (MMIF) approach for images. Image fusion if medical image is processed including computerized tomography (CT), positron emissions tomography (PET), magnetic resonance based imaging (MRI), the 6 broad categories of images in spatial domain, The 3 MMIF layers are pixel, in order feature, and judgment. Ch.Hima Bindu et al [6] used the artificially trained neural networks (ANN) and Deep Learning (DL) based sensor fusion for the self-driving cars, for FR, and identifying cancer using neuro-imaging specimens,. The optimization algorithms are used under consideration, the rate of learning and its adaptation. All of these techniques and approaches are sound and acceptable, but the necessary design lacks a solid foundation.

Dr. D Mohana Geetha et al [7] proposed combining of images for determining the cause and treatment of illness using medical image refinement. Many of the clinical modality images are combined using fusion as MRI, PET, CT, and single-photon release determined tomography (SPECT), Vaishali Kamble et al [8] investigated and proposed a reliable approach for identifying children that includes Deep Learning algorithms, intelligent machines classification approaches, and DCT features. The mid- and high-energy bands of the DCT factor are used to derive the handmade signature traits. The Gaussian Nave Base (GNB) classifier is the best machine learning method of classification for determining the proportion of matches between training and evaluation images. The transferrable way of learning is also used to extract deeper attributes for calculating the recognition score. The two models are fused at the rating level to improve prediction precision and durability.

Jayanta M et al [9] long back proposed method for colour improvement straightforward but more efficient than many of the before mentioned current methods. The examination of the colour and spatial domain colour enhancement strategy tare compared with the proposed DC coefficient scaling approach as designed in compressed DCT dooming. Approach seems to offer extremely good improvement is used to contrast the outcomes of all prior methods with the particular approach that is being suggested. Prateek S. Sengar et al [10] letter have replaced DCT with DWT to enhance the images. The factors approach [CES-DCT] and it is discovered that the CES method is less complicated but more efficient than many of those earlier recommended improvement strategies. The Consumer Electronics Show (CES) technique is new because it addresses the colour parts, whereas other techniques just addressed the luminance element. The CES-DWT improves both local as well as global contrast while maintaining colour constancy by utilizing the benefits of the wave transformation. Shutao Li et al [11] -have study thorough analysis of contemporary pixel-level picture fusion techniques. The current fusion evaluations are then compiled. The obstacles in pixel-level combination uses are then examined for four primary programmers, including satellite imagery for medical diagnostics, monitoring, imaging, and hurdles. Finally, this research comes to the conclusion that even though several picture fusion techniques have been put forth, there are still a number of potential future avenues for diverse fusion of images implementations. Irene Fondon et al [12] provides a technique for enhancing and accelerating CNN instruction for healthcare imaging processing tasks by proactively choosing classified incorrectly positive training data. Heuristically selected samples for training are based on categorization using the CNN's most recent state. By training a CNN both with and without the use of the selective sampling strategy (SeS and NSeS), we assessed and contrasted our suggested approach.

Agung W. Setiawan et al [13] discovered that the G channel transmits more significant data than the others in RGB colour retinal vision. The authors study this ocular image characteristic in order to develop a more effective picture coding system. There are three coding methods used: balanced R way, G way, and B channel code. They have proposed the contrast limiting equalization of the histogram (CLAHE) approach2is proposed in the spatial domain for the color image enhancing. Many fusion approaches have been offered in the past, but it is still proposed to preserve the brightness. Primarily in this work the image fusion based approach is expected to implement with the goal of the contrast enactment.

III. WAVELET BASED FUSION

This method entails wavelet domain transformation of the input images. The coefficients of wavelets are subsequently merged using a variety of techniques, including weighted averaging or maximal selections. To create the final image, the resulting wavelet coefficients are transformed again into the spatial domain of the image. There are three major steps of the Wavelet based fusion 1) decompose the image to sub bands. 2) apply the suitable fusion rules to fuse the coefficients, 3) finally again reconstruct image back using inverse transform.

IV. PROPOSED FUSION BASED ENHANCEMENT

The proposed block diagram of the hybrid transform based fusion approach is shown in the Figure 2.

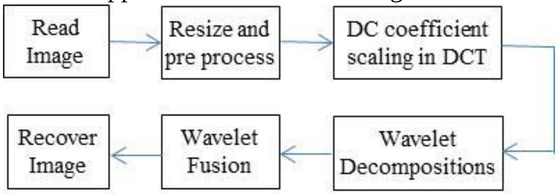
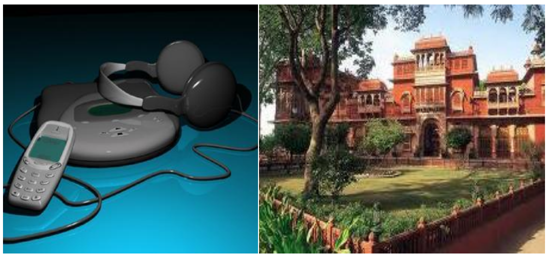


Fig. 2 Proposed Block diagram of the Hybrid Fusion approach.

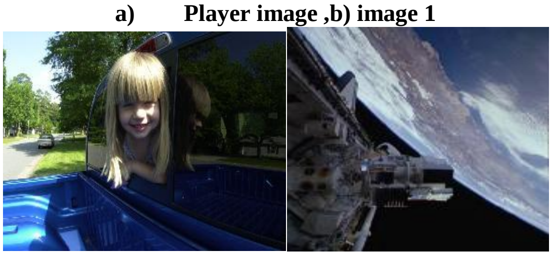
The image is first resized to 3:2 sizes and then LAB colour space is converted and L component is exposed to DCT. The DC coefficient of DCT is augmented for enhancing the contrast. Then to enhance the entropy of the image the wavelet based fusion is proposed in second phase. The two level of DWT decomposition is proposed and then LL coefficients of both input images are fused using the pixel level averaging.

V. RESULTS AND DISCUSSIONS

This section preseted the some of the proposed results of the fusion based enhancement approach. The input mages used for the study and analysis are shown in the Figure 3.



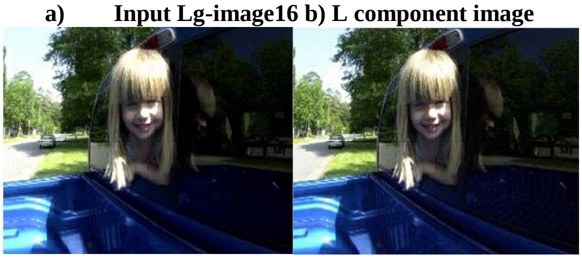
a) Player image ,b) image 1



b) Lg-image16 , d) satellite image

Fig. 3 Input color image data used in study

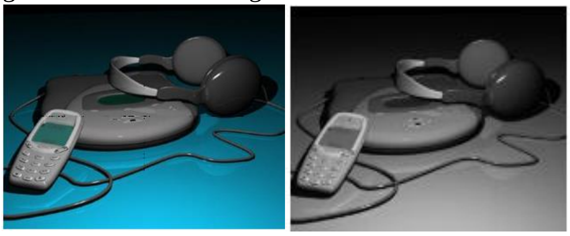
a) Input Lg-image16 b) L component image



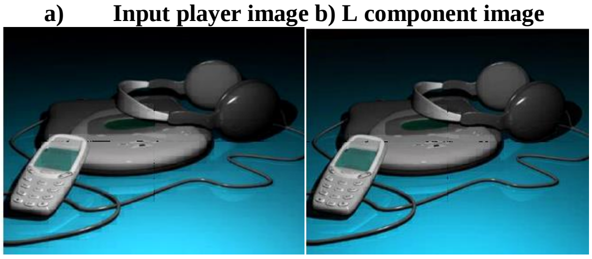
b) DC coefficient enhanced f) Fused image results

Fig. 4 Results of the contract enhancement using image fusion for Lg-image16

Results of the fused color contrast enhancing for images are shown in the Figure 4.



a) Input player image b) L component image



a) DC coefficient enhanced f) Fused image results

Fig. 5 Results of the contract enhancement using image fusion for player image with non-uniform illumination

Table 1. Entropy analysis results

Image	With DC adjustment	With proposed Fusion
Lg-image 16	3.0631	7.1487
Player	3.9095	7.3034
Satellite image	3.0259	7.5510

Table 2. Mean brightness results

Image	**With DC adjustment**	**With proposed Fusion**
Lg-image 16	**55.2437**	**65.1346**
Player	**73.1323**	**70.1846**
Satellite image	**96.867**	**92.0616**

The result of the parametric evaluation is preseted in the Table 1 and Table 2 respectively for the Entropy and the Mean Brightness.

VI. CONCLUSIONS AND FUTURE SCOPE

Low-cost digital cameras frequently take pictures that aren't the same hue and brightness as the situation actually is. Uneven lighting, over- or underexposure of some areas, and inadvertent camera user motions are just a few of the factors that contribute to low contrast photos. As a result, methods for increasing contrast are required to further enhance the aesthetic appeal of colour images.

In this research, it is suggested to adopt the wavelet-based image fusion approach to improve image quality. Initially, the compressed DCT domains of the DC coefficients augmentation methodology are used to locally construct the contrast difference image from the input image. Using pixel level fusion rules, the scaled contrast image is fused to the image being tested in the second run.

It is found that fused image is capable of preserving brightness and improving contrast with higher SNR range.

In Future the optimization methods might be used for improving the contrast efficiency. Also the adaptive contrast enhancement is required to implement in future.

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