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A Review Paper Based on Image Quality after Transformation

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Abstract: *In this review paper, we have studied various techniques of Hue preserving improvement in quality of colour Images. Image enhancement is used to improve the quality of an image for visual perception of human beings. The main techniques for image enhancement such as contrast stretching, slicing, histogram equalization etc. for grey scale images are discussed in many books. The generalization of these techniques to colour images is not straight forward. Unlike grey scale images, there are some factors in colour images like hue which need to be properly taken care of for enhancement. In many colour image enhancing techniques for processing intensity and saturation in colour images keeping hue unaffected is the transformation of the image data from RGB space to other colour spaces such as HSL (hue-saturation-lightness), HIS (hue-saturation-intensity), YIQ, HSV (hue-saturation-value), etc. Transforming from one space to another and processing in these spaces usually generate gamut problem, i.e., the values of the variables may not be in their respective intervals.*

Keyword: Grey scale image, RGB (Red-Green-Blue)

1. Introduction

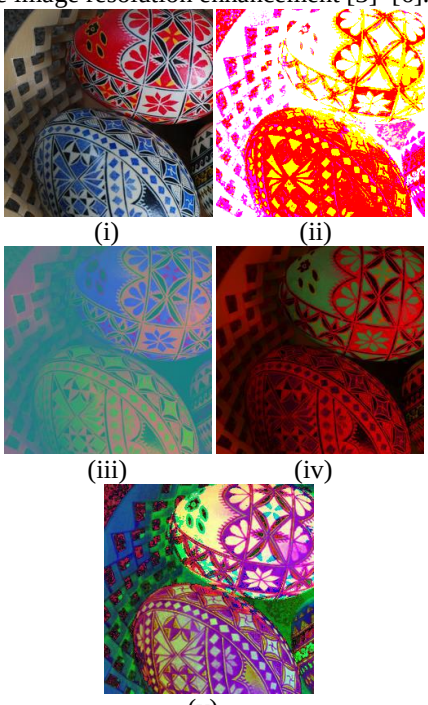
IMAGE enhancement is used to improve the quality of an image for visual perception of human beings. It is also used for low level vision applications. It is a task in which the set of pixel values of one image is transformed to a new set of pixel values so that the new image formed is visually pleasing and is also more suitable for analysis [1]. The generalization of these techniques to colour images is not so easy. Unlike gray scale images, there are some factors in colour images like hue which need to be properly taken care of for enhancement. These are going to be discussed below. Several algorithms are available for contrast enhancement in grey scale images, which change the grey values of pixels depending on the criteria for enhancement [2]. On the other hand, literature on the enhancement of colour images is not as rich as grey scale image enhancement.

Hue, saturation and intensity are the attributes of colour. Hue is that attribute of a colour which decides what kind of colour it is, i.e. a red or an orange. In the spectrum each colour is at the maximum purity (or strength or richness) that the eye can appreciate, and the spectrum of colours is described as fully saturated. If a saturated colour is diluted by being mixed with other colours or with white light, its richness or saturation is decreased. For the purpose of enhancing a colour image, it is to be seen that hue should not change for any pixel. If hue is changed then the colour gets changed, thereby distorting the image [3-6]. Consider the case where the pixel values go out of bounds after processing, due to the nonlinear nature of the uniform colour spaces, conversion from these spaces with modified intensity and saturation values to RGB space generates gamut problem. In general this problem is tackled either by clipping the out of boundary values to the bounds or by normalization. Clipping the values to the bounds creates undesired shift of hue and normalization reduces some of the achieved intensity in the process of enhancement which is against its objective [4-5].

Image resolution enhancement techniques can be categorized into two major classes according to the domain that they are applied in:

1) Image domain and
2) Transform domain.

The techniques in the image domain use the statistical and geometric data directly extracted from the input image itself [1-2] while transform-domain techniques use transformations such as decimated discrete wavelet transform (DWT) to achieve the image resolution enhancement [3]–[6].



(i) (ii) (iii) (iv) (v)

Figure 1: Display of LC #127 Image in Different Color Spaces
(i) RGB Color Space, (ii) LAB Color Space, (iii) YCbCr Color Space, (iv) YIQ Color Space, and (v) HSV Color Space

2. Review Work

Turgay Celik et. al [1] recommended a method for image resolution enhancement from a single LR image using the dual-tree complex wavelet. The initial rough estimate of the

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HR image is decomposed to estimate the complex-valued high-pass wavelet coefficients for the input LR image. The estimated complex wavelet coefficients are used, together with the input LR image, to reconstruct the resultant HR image by employing IDT-CWT. Extensive tests and comparisons with the state-of-the-art methods show the superiority of the method presented in this letter. This proposed resolution enhancement method retains both intensity and geometric features of the LR image.

Muna F. Al-Samaraie et. al [2] presented an image enhancement algorithm based on the weighted filter, histogram equalization and wavelet transformation to solve this Hue problem. We studied the experimental result which shows that the proposed approach can enhance the high-contrast images effectively; it not only improves the global brightness and contrast of images but also preserves details and remove noise. The other advantage of this method is that it is fully automatic and requires no parameter settings. Therefore, it is useful and suitable for most digital camera users.

Gwanggil Jeon et. al [3] proposed a luminosity conserving and contrast enhancing histogram equalization method for colour images was presented. In literature, various histogram equalization methods for gray-level images have been proposed. However, they are not well-suited in colour space. In this paper, original image is transformed in other colour spaces, and histogram equalization process is applied in particular channels. Simulation results show that the HSV colour space gives the best performance.

Renbin Peng et. al [4] developed an image enhancement system based on SR noise, for improving the suboptimal image enhancers which suffer from model mismatch and yield unsatisfactory enhancement results. The principle of SR noise-refined image enhancement was investigated, and a genetic algorithm-based MOO method was used to find the SR noise solution, in which the HVS preference was included via a weighting scheme for reducing the size of the solution set. Four types of SR noises were employed in the system and a variety of enhancement algorithms were investigated in this paper. Experimental results show that the presented system has highly encouraging performance in terms of simplicity, flexibility, efficiency and robustness, which demonstrates SR noise's capability of improving the suboptimal enhancers and supports its real-world CAD application. Wei-Ming Ke et. al[5] proposed an innovative image enhancement framework consisting of BiTA and SWCE. This approach modifies the traditional gamma adjustment curve using the BiGA algorithm. BiGA adjusts global luminance and limits the contrast lost by analyzing and setting the parameter γ. SWCE integrates the saliency map with a simple contrast enhancement method, and performs more enhancements in regions that humans pay greater attention to. This paper showed that SWCE achieves great performance using the luminance component. To evaluate the enhancement performance, the ratio of SWRE/N level was then used to measure the quality of enhancement. This paper also conducted a human rating experiment to strengthen objectivity. Based on the proposed evaluation metrics, this enhanced result outperforms various existing methods of contrast enhancement.

In this paper *Karen Panetta et. al* [6], we studied a parameterized LIP (PLIP) model that spans both the linear arithmetic and LIP operations and all scenarios in between within a single unified model. We also studied both frequency and spatial domain PLIP-based image enhancement methods, including the PLIP Lee's algorithm, PLIP bi-histogram equalization, and the PLIP alpha rooting. In this paper computer simulations and comparisons demonstrate that the new PLIP model allows the user to obtain improved enhancement performance by changing only the PLIP parameters, to yield better image fusion results by utilizing the PLIP addition or image multiplication, to represent a larger span of cases than the LIP and linear arithmetic cases by changing parameters, and to utilize and illustrate the logarithmic exponential operation for image fusion and enhancement.

In this paper *Tang Shiwei1 et. al* [7], a new function and fuzzy enhancement operator was defined to overcome the shortcomings of Pal-King algorithm. A large number of experiments show that: the image contrast with the improved algorithm is obviously enhanced, and the edge information of the low gray value is kept well, and it only needs 2 or 3 times to achieve good results. In addition, this algorithm is simpler and faster than Pal-King algorithm. Hence, the improved algorithm in this paper is an effective image enhancement algorithm based on fuzzy sets.

In this paper *Tzu-Cheng Jen et. al* [8], proposed an effective Bayesian framework for image enhancement. The proposed posteriori distribution function merges both local structure and local gradient information into the enhancement process. With proper simplification, they deduce an efficient method to generate an intensity transfer function that may achieve similar enhancement performance with much lower computational complexity. Simulation results have demonstrated the feasibility and effectiveness of the simplified MAP-based method for image enhancement.

In this paper *Changhyun Kim et. al* [9] proposed an enhancement algorithm for an IR image by using its aligned high resolution visible image. To improve edge sharpness of the IR image without introducing blurring and distortion, they introduced the visible-image-driven diffusion based on the weight map representing edge correspondences. They also applied de-blurring to improve the remaining area. The performance of the algorithm was evaluated on several data sets and experimental results show that the proposed algorithm produces quality-improved IR images with sharp edges.

In this paper *Joonwhoan Lee et. al* [10] proposed a method for image enhancement in HSV space based on the local processing of image. Because of H and S component are not changed during enhancement, the original color of the enhanced image is not altered. Based upon the subjective and objective performance evaluation this method proved to be

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efficient in image enhancement. The objective criteria like Detail Variance - Background Variance, and statistical characteristics shows that this method produces better images in comparison to other methods like histogram equalization, MSRCR, and AINDANE.

In this paper *Kashif Iqbal et. al* [11], have proposed and described an image enhancement method for biometric security purposes. The proposed method wss based on the integration of contrast enhancement and enhanced colour balancing methods. In order to evaluate the performance of the proposed method three face detection methods were applied to surveillance images before and after enhancement using the proposed method. On each occasion significant improvement in face detection was achieved after enhancing the images using the proposed method. These results demonstrate the effectiveness of this method and show the potential in the area of biometric security.

3. Proposed Methodology

By this review study, we have suggested an effective way of tackling the gamut problem during the processing itself. It is not necessary to bring back the R, G, and B values to its bounds after the processing. Proposed algorithm does not reduce the achieved intensity by the enhancement process. The enhancement procedure suggested here is hue preserving. It generalizes the existing grey scale image enhancement techniques to colour images. The processing has been done in RGB space itself and the saturation and hue values of pixels are not needed for the processing.

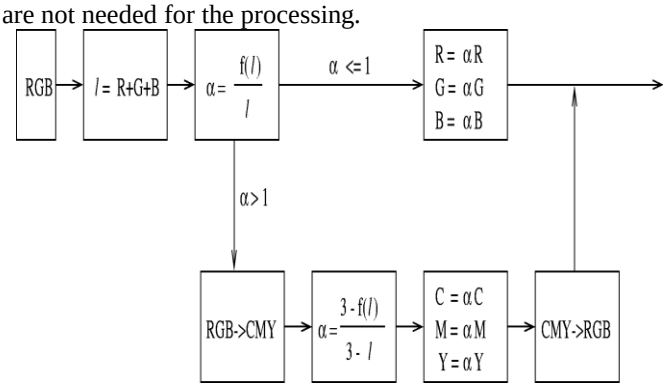

Figure 2: Block diagram of the proposed enhancement scheme

The proposed hue preserving color image contrast enhancement algorithm that will avoid the gamut problem. Furthermore, by taking care of the simple architectural principles of processors, the proposed algorithm has been made computationally very efficient and fast.

The algorithm is given below:

Repeat for every pixel:

(i) Collecting required information

Find the maximum, minimum and intermediate out of the R, G and B values xmin, xmax and xin term respectively.

(ii) Contrast Enhancement

para=128 ('=' is for assignment)

If (xmax – xmin) < para
Then:
xnorm = (float)xintermediate / 255
alpha = grayFunc(xnorm) / xnorm
If (alpha* (float)xmax) > 255
Then:
xnorm = xmax / 255
alpha = grayFunc(xnorm) / xnorm
x1 = alpha * x1
x2 = alpha * x2
x3 = alpha * x3

4. Conclusion

A principle is suggested to make the transformations gamut problem free, using the same principle as class of hue preserving contrast enhancement transformations are proposed, which generalize the existing gray scale contrast intensification techniques to colour images. These transformations are also seen to bypass the above mentioned colour coordinate transformations for image enhancement.

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