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MULTISCALE COLOR RESTORATION IN FACE DETECTION & RECOGNIZATION

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Abstract

Digital Image enhancement provides a multitude of choices for improving the visual quality of images. When the details of image are lost due to various reasons, image enhancement has been applied. Many algorithms have been proposed for image enhancement in the past decade. Multi-Scale Color Restoration algorithms are used to enhance image quality and some algorithms come with undesired drawbacks like the loss of tiny details, enhancement of image noise, occasional over enhancement and unnatural look of the processed images. This paper proposes new algorithms for quality enhancement of images in spatial domain based on edge operators. Experimental results show that the proposed algorithms provide a flexible and reliable way for quality enhancement over the traditional high pass filter.

Introduction

The dynamic range of a camera is much lesser than that of human visual system. This causes images taken by the camera to look different from how the scene would have looked to a naked eye. Multi Scale with Color Restoration (MSRCR) algorithm enhances images taken under a wide range of nonlinear illumination conditions to the level that a user would have perceived it in real time. But there are parameters used in this enhancement method that are image dependent and have to be varied based on the images under consideration. In this paper we propose a completely automated approach for MSRCR by obtaining parameter values from the image being enhanced. Color recovery (or color restoration) is a process which can restore lost color, specifically to television programmes which were originally transmitted in color, but for which only black & white copies remain archived.[1] Not to be confused with colorization, color recovery is a newer process [2] and is fundamentally different from colorization for several reasons.[2] Firstly, color recovery can only be performed if the originally transmitted color signal can be reconstructed or recovered from some source, whereas this is not usually the case for traditional colorization. Secondly, colorization can be used to colorize films and programmes that were made in black and white, using still color photos and/or some educated guesswork to manually choose a color palette. Conversely, the goal of color recovery is to reinstate (as closely as possible) the color signals of programmes originally made in color as they were first seen. Color recovery reconstructs the color information from actual recovered signals and theoretically without depending on guesswork.

Literature Review

In order to improve the visual quality of digital images, many image processing techniques have been proposed, like gamma adjustment, histogram equalization, adaptive histogram equalization, homomorphism filtering, and Retinex-based algorithms. Among these approaches, the multi-scale retinex with color restoration (MSRCR) is a widely used method based on

Land's theory of human visual perception X [1] X X[2]X. Inspired by the receptive field structures of neurophysiology, Land introduced in [2] the use of a center/surround spatial kernel for the modeling of human's color vision. Based on the same center/surround spatial kernel, the MSRCR method adopted a set of multi-scale Gaussian filters as the surrounding function to achieve both color constancy and contrast/lightness at the same time X[3]X[4]X. However, the MSRCR method requires high computational complexity and may sometimes cause artifacts in the enhanced images. On the other hand, AINDANE (Adaptive and Integrated Neighborhood Dependent Approach for Nonlinear Enhancement) X [5] X is a new algorithm for the improvement of image quality under extremely low or non-uniform lighting conditions. This method relies on the statistical information of the input image and is composed of two separate processes: adaptive luminance enhancement and adaptive contrast enhancement. If compared to the MSRCR method, this method requires lower computational complexity and may produce fewer artifacts in the enhanced images. Even though both MSRCR and AINDANE can successfully improve the local contrast of images for low illumination conditions, they have difficulty in handling overly illuminated situations. Moreover, these two methods may sometimes overly enhance image contrast and produce unnatural-looking images. In this paper, we propose a local gamma adjustment algorithm to virtually expand the dynamic range of displayed images. Image details are automatically enhanced based on the estimation of local image details in the original image. By individually adjusting the local gamma value over the R, G, and B color channels, image colorfulness can be properly enhanced. The proposed algorithm requires low computational complexity and may provide enhancement results comparable to, or even better than, manually adjusted images.

Methodology

This project training phase consists of following steps:

1. Input an image

2. Detect skin region in an input images
3. Crop skin region
4. Apply Multi scale color restoration on crop region.
5. Save Image into training directory.
6. Train Neural Network using genetic algorithm on training Images directory.

This project testing phase consists of following steps:

7. Input an image
8. Detect skin region in an input images
9. Crop skin region
10. Apply Multi scale color restoration on crop region
11. Recognize image with train directory images
12. Display result

Input Image

A system camera is used to capture an image and to provide an input to this current project. A camera must be of 2.5 or 3.0 pixel resolution to get a more precise result.

Detect Skin Region

To avoid unnecessary image region (region other than face), we first of all detect skin color in input captured image. From the previous study it is observed that skin color pixels are in the range of 120 to 180 of their decimal value

$120 \leq sp \leq 180$ E.q -----3.1

Where $s_p = (p_r + p_g + p_b) /3$ E.q----3.2

The face detection base on skin color is vital step of project that illuminates processing of wrong input image. The below data flow diagram shows the face detection base on skin colure Detection of skin color in color images is a very popular and useful technique for face detection. Many techniques [12], [13] have reported for locating skin color regions in the input image. While the input color image is typically in the RGB format, these techniques usually use color components in the color space, such as the HSV or YIQ formats. That is because RGB components are subject to the lighting conditions thus the face detection may fail if the lighting condition changesAmong many color spaces, this project used YCbCr components

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since it is one of existing Matlab functions thus would save the computation time. In the YCbCr color space, the luminance information is contained in Y component; and, the chrominance information is in Cb and Cr.

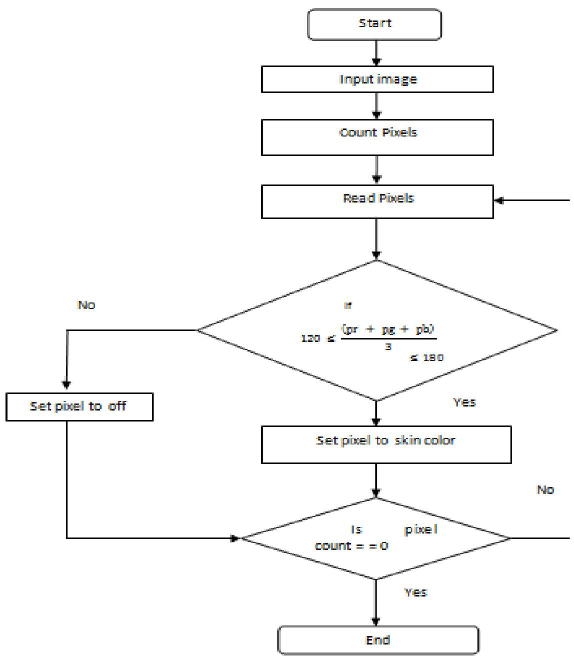

Figure 3.1 Data Flow Diagram of Skin color Detection

. Therefore, the luminance information can be easily de-embedded. The RGB components were converted to the YCbCr components using the following formula.

$$Y = 0.299R + 0.587G + 0.114B \qquad \text{E.q----3.3}$$

$$C_b = -0.169R - 0.332G + 0.500B \qquad \text{E.q----3.4}$$

$$C_r = 0.500R - 0.419G - 0.081B \qquad \text{E.q----3.5}$$

In the skin color detection process, each pixel was classified as skin or non-skin based on its color components. The detection window for skin color was determined based on the mean and standard deviation of Cb and Cr component, obtained using 164 training faces in 7 input images. The Cb and Cr components of 164 faces are plotted in the color space in Fig.3.2; their histogram distribution is shown in Fig. 2.

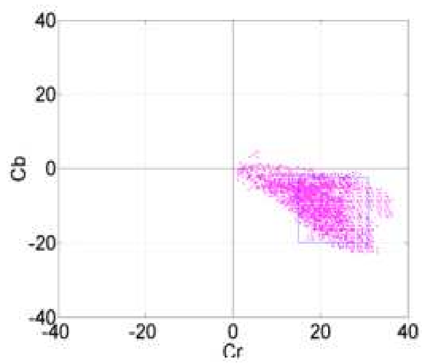

Figure 3.2 Skin pixels in YCbCr color space

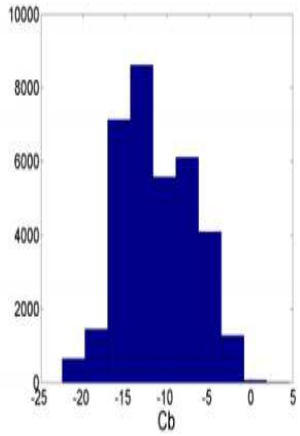

Figure 3.3 Histogram distribution of Cb

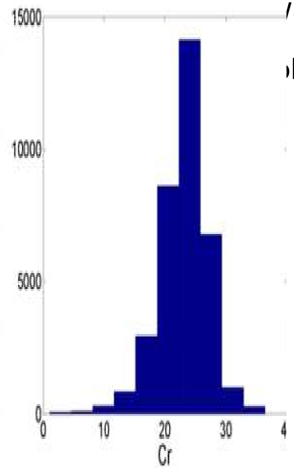

Figure 3.4 Histogram distribution of Cr

Crop the skin region

Cropping [1] refers to removing unwanted areas from a photographic or illustrated image. One of the most basic photo manipulation processes, it is performed in order to remove an unwanted subject or irrelevant detail from a photo, change its aspect ratio, or to improve the overall composition. Once the skin region is identified, we crop skin region into rectangular area of dynamic size

Apply Multi-Scale Color Restoration on Cropped Region (MSCR)

Multiscale color restoration is technique to restore original color of image whose pixels are distorted because of noise induction. e propose MSCR method that work on llowing principle

1. The image pixels should not be totally of or on i.e. white and black pixels.
2. Pixels should be of range $10 \leq pi \leq 245$
3. Collect all those pixels cluster wise which are closer to either dark or white color.
4. Set all those pixels closer to either dark or white color to average skin color without affecting internal contains of skin region.
5. Repeat step 3 until all cluster of identified skin region are set to average skin color

Before applying MSCR technique on Image Pixels, an Image is segmented into region to identify an area where to apply MSCR.

$Si = \int_{1}^{n} \int |Pi - Pi + 1|.n$ E.q-----3.5

Where

S_i=Image Segment

N=Total Number of Pixels in an Image

P*i*=Current Pixel value.

Setting New Value to Custer pixels as per equation

$$Si = e^{n}\sqrt{\frac{Sin(P(i) + P(i+1) + \ \dots\dots..+P(n))}{n}} \quad \text{E.q 3.6}$$

If

$10 \le si < 245$ E.q----3.7

Then

$$Si = e^{n-1}\sqrt{\frac{Sin(P(i)+P(i+1)+ \ \dots\dots..+P(n))}{\frac{n}{2}}} \quad \text{E.q 3.8}$$

Finally user can modify MSCR image enhancement by setting thorough program code.

Training Neural Network using Genetic algorithm (Training Phase)

The training of feed-forward Neural Networks (NNs) by back propagation (BP) is much time-consuming and complex task of great importance. To overcome this problem, we apply Genetic Algorithm (GA) to determine parameters of NN automatically and propose efficient GA which reduces its iterative computation time for enhancing the training capacity of NN. Proposed GA is based on steady-state model among continuous generation model and used the modified tournament selection, as well as special survival condition. To show the validity of the proposed method, we compare with conventional and the survival-based GA using mathematical optimization problems and set covering problem. In addition, we estimate the performance of training the layered feed forward NN with GA. Genetic algorithms are often thought of, discussed and implemented using binary strings, or bit strings. Each gene or bit represents the expression of a state. If the bit is turned on, then the gene corresponding to that bit can be said to be “expressed". In this application a bit represents the state of either a variable being included (“1”) or not included (“0”) in the final solution. Genetic algorithms sometimes require the use of special operators in order to simulate the evolutionary processes which they emulate. The most common operators are crossover and mutation. The crossover operator takes two parent chromosomes and combines them to produce an offspring. A common form of crossover operator is uniform crossover. In uniform crossover, if a specific gene is turned on in both parents, then it will be turned on in the offspring. If a gene is turned on in only one of the parents, then it may be turned on in the offspring. Uniform crossover was used in this project. The mutation operator is applied independently but immediately following the crossover operator. A mutation is a random change of a gene in a chromosome, and is applied according to a preset mutation rate. A survival rate that determines what percentage of the population i.e. the fittest members would survive into the next generation was employed. Because the computational cost of building and training neural network models from scratch can be high, another feature employed in this work was to guarantee that when a new offspring is generated it does not duplicate any chromosome currently in the population or which has been previously built and tested

Face Reorganization with Trained Directory Images

The pattern set of images are obtained and the mean faces is taken as the reference for a face structure. All the images in the training directory are compared with the input face and the correlation between them is found out. Non-face areas will have low correlation while face areas will have high correlation. Then the training images (Except first three) having less value of correlation are discarded. Since the training images can be of any size, the face is stored in different sizes starting from 30 pixels to 220 pixels at the step of 10 pixels (boxes are square boxes).

Experiment Result

Image	**Image 1**	**Image 2**	**Image 3**
% of Superiority	60.98	65.40	63.92
	Image 4	**Image 5**	**Image 5**
% of Superiority	68.34	66.23	64.35

Table 1 Image Superiority

	
Input 1	MSCR Result Image 1
	
Input 2	MSCR Result Image 2
	
Input 3	MSCR Result Image 3

Table 2 Result of MSCR proposed Method

	Filter	PSNR	CC	SS
Image1	HPF	17.459993	0.123383	0.462605
	AWMF	21.208031	0.945692	0.339348
	EASF	24.446018	0.973322	0.510785
	EAHF	24.596769	0.974237	0.519020
Image2	HPF	18.615047	0.073046	0.401759
	AWMF	21.600517	0.965229	0.243731
	EASF	25.512057	0.985542	0.568655
	EAHF	25.921262	0.986839	0.574605
Image2	HPF	17.034144	0.216205	0.534502
	AWMF	21.351333	0.943476	0.449520
	EASF	23.94478	0.967846	0.566640
	EAHF	24.186566	0.969577	0.577373

Results of Edge Preserving Contrast Enhancement Filters

Images	PSNR
Image 1	20.325
Image 2	21.474
Image 3	19.5783
Image 4	23.4789

PSNR Calculated after MSCR on Input Face

Conclusions

In this paper, three filters are proposed for contrast enhancement based on edge operators. After distinguishing edge regions from flat regions, separate filters are applied accordingly. In future, to provide a natural looking processing result, it is planned to apply histogram equalization to the outputs from these filters. Experimental results do demonstrate the superiority of the proposed approaches over the traditional high pass filter.

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