Conversion of Grayscale Images into Colour

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ABSTRACT

Images are of many types. Color, Black and White, Grayscale, Negative. These types differ from each other in their color ratio, their color palette, and their format sometimes. It is that is why very prudent to keep to a certain format while working with pictures, as it is almost impossible to convert one format into other. But nowadays, codes, algorithms and the introduction of new technologies have made it possible to convert one format into other. This paper provides a brief review about one of those techniques and technologies.

Keywords:-Color Conversion, Code Generation,

1. INTRODUCTION

Colorization is the term which means to color any grey scale image. In digital image processingterms colorization of grayscale image is nothing but assigning the red, green and blue colorcomponent values to each grey value of grayscale image. Colorization is very difficult because it involves assigning three-dimensional (RGB) pixel values to an image which varies along only one dimension (luminance or intensity). Since different colors may have the same luminance value but vary in hue or saturation, the problem of colorizing grayscale images has no inherently 'unique' solution. So user intervention becomes trivial in colorization process toselect the 'better' match (red, green and blue values) for every grayscale pixel. In [2],[3] authorshave proposed some of the simple approaches for colorization of grayscale images, where userintervention is needed only to select the source color image to be used to generate color palette.

In [1], [5] different color spaces and pixel window sizes are worked out for coloring grayscaleimages. All these techniques gives the results subjective to the source color image considered forcoloring are very heavy with respect to time complexity. To speed up the process different searchalgorithms are proposed in [2], [5]. But everywhere the size of source color image is assumed tobe equal to or more than to be colored target grayscale image. The paper presents novelcolorization technique where this size dependency of source color image and target grayscaleimage are taken out. Also newly introduced Biorthogonal color spaces are used here andtheir performance is compared with and found better than RGB color space.

The proposed technique generates color palette using vector quantization codebook generation approach. Here fast codebook generation (KFCG) [17], [21], [22] algorithm is used.

2. QUANTIZATION OF VECTORS

Vector Quantization (VQ) [15-21] is an efficient technique for data compression and has been successfully used in variety of research fields such as video-based event detection and anomaly intrusion detection systems, image segmentation

[16-19], speech data compression [15], CBIR [21,22] and face recognition [20]. VQ [14-31] can be defined as the mapping function that maps kdimensional vector space to the finite set **CB = { C1, C2, C3, ..., CN}**. The set CB is called codebook consisting of N number of codevectors and each codevectorCi = {ci1, ci2, ci3, ……,cik} is of dimension k. The key to VQ is the good codebook.

3. ALGORITHM

Here the Fast Codebook Generation algorithm given in [17],[21],[22] for image data compression is used. This algorithm reduces the time of code book generation. Initially we have one cluster with the entire training vectors and the code vector C1 which is centroid. In the first iteration of the algorithm, the clusters are formed by comparing first element of training vector with first element of code vector C1. The vector Xi is grouped into the cluster 1 if xi1< c11 otherwise vector Xi is grouped into cluster 2 as shown in Figure 1.a. where code vector dimension space is 2. In second iteration, the cluster 1 is split into two by comparing second element xi2 of vector Xi belonging to cluster 1 with that of the second element of the code vector. Cluster 2 is split into two by comparing the second element xi2 of vector Xi belonging to cluster 2 with that of the second element of the code vector as shown in Figure 1.b. This procedure is repeated till the codebook size is reached to the size specified by user. It is observed that this algorithm gives less error as compared to LBG and requires least time to generate codebook as compared to other algorithms, as it does not require any computation of Euclidean distance. The algorithm shown in Figure 1.a. and Figure 1.b. for two dimensional case it is easily extended to higherdimensions.

4. WORKING SETUP

As tuples of numbers, typically as three or four values or color components. Color space is set of colors where the color model is associated with a precise description of how the components are to be interpreted.

A) RGB Color Space

RGB uses additive color mixing, because it describes what kind of light needs to be emitted toproduce a given color. Light is added together to create form from out of the darkness. RGBstores individual values for red, green and blue.

B) BiorthogonalColor Spaces

Novel Biorthogonalcolor spaces are introduced here. Three versions of the same namely Biorthogonal Red colorspace(YCrgCrb), Biorthogonal Green color space(YCgrCgb) and Biorthogonal Blue color space(YCbgCbr) have been used for colorization of greyscale images with fast codebook generation (KFCG) algorithm.

a. Biorthogonal Red color space(YCrgCrb)

To get YCrgCrb components we need the conversion of RGB to YCrgCrb components. The RGB to YCrgCrb conversion matrix given in equation 1 gives the Y, Crg, Crb components of color image for respective R, G, B components.

Y 1 1 1 R

Crg = 1 -1 0 G . . . .(1)

Crb 1 0 -1 B

The YCrgCrb to RGB conversion matrix given in equation 2 gives the R, G, B components of color image for respective Y, Crg, Crb components.

R 1 1 1 R

G =1/3 1 -2 1 Crg . . . .(2)

B 1 1 -2 Crb

b. Biorthogonal Green color space(YCgrCgb)

To get YCrgCrb components we need the conversion of RGB to YCgrCgb components. TheRGB toYCgrCgb conversion matrix given in equation (3) gives the Y,Cgr,Cgb components of color image for respective R, G, B components.

Y 1 1 1 R

Cgr = 1 -1 0 G . . . .(3)

Cgb 0 1 -1 B

The YCgrCgb to RGB conversion matrix given in equation (4) gives the R, G, B components of color image for respective Y,Cgr,Cgb components.

R 1 2 1 R
G =1/3 1 -1 1 Cgr . . . .(4)
B 1 -1 -2 Cgb

c. Biorthogonal Blue color space(YCbgCbr)

To get YCbgCbr components we need the conversion of RGB to YCbgCbr components. The RGB to YCbgCbr conversion matrix given in equation (5) gives the Y,Cbg,Cbr components of color image for respective R, G, B components.

Y 1 1 1 R
Cbg = 0 1 -1 G . . . .(5)
Cbr 1 -1 0 B

The YCbgCbr to RGB conversion matrix given in equation (6) gives the R, G, B components of color image for respective Y,Cbg,Cbr components.

R 1 1 2 Y
G =1/3 1 1 -1 Cbg . . . .(6)
B 1 -2 1 Cbr

5. WORKING TECHNIQUES

The colorization technique can be divided into main steps [1-5] as preparing color palette from source image and colorization of greyscale image using this color palette.

A. Color Palette Generation using KFCG

The steps generates color palette as the VQ codebook of source color image.

i. In case of Biorthogonal Red color space convert source color image to Biorthogonal Red color space using equation 1. Similarly in case of Green and Blue domain convert source color image to Green and Blue color spaces using equation 3 and 5 respectivly.

ii. This source color image is divided into pixel windows of size 2x2 (each pixel consisting of red, green and blue components).

iii. These are put in a row to get 12 values per vector (as 4 sets of Y, Crg and Crb values in YCrgCrbcolor space or 4 sets of R, G and B values in RGB color space or 4 sets of red, green and blue values in RGB colorspace). Collection of these vectors is a training set (initial cluster).

iv. The Fast codebook generation algorithm is applied on this initial training set to obtain the codebook of specific size (here four sizes are considered 64, 128, 256).

B. Greyscale Image Colorization

The target greyscale image is divided into pixel windows of size 2x2. These 4 values are put into the row and are compared with GR component of all the codevectors in RGB color space, with Y component of the all the codevectors in YCrgCrbcolor space and with average of RGB for each of the four pixels of the codevector in RGB color space. The closest match in the color palette is determined by calculating the Euclidean distance between Y or Average RGB of four values in color palette (Codebook) and greyscale pixel window values from the grey image. The direct Euclidian distance between pixel window row P and the color palette row Q of added columns can be given as below

6. CONCLUSION

Colorization improves the perceptibility of greyscale image to great extent. The technique of greyscale image colorization is presented in the paper with help of VQ codebbook generation algorithm KFCG and Biorthogonalcolr spaces. The technique helps to overcome the assumption of having source color image size bigger than the target greyscale for coloring considered in earlier approaches,as the fixed codebook size is used. In all 16 versions of proposed technique for 4 codebook sizes (32,64,128,256) with 4 color spaces like RGB andnewly introduced Biorhogonal Red, Green and Blue color spaces are proposed and compared in the paper. From the results one can conclude that, increasing codebook size improves (up to128)the quality of coloring up to certain extent. In all Biorthogonal Green color space gives better colorization even at minimum codebook size.

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