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Color Embedding Into Textured Gray Image

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Abstract

In this paper reversible method is proposed to convert color images to gray images. Color documents and images are converted in to gray images by embedding colors as low visibility high frequency textures in gray images. More specifically, the color image (RGB) is converted in to luminance (Y) and chrominance components (Cb, Cr). A wavelet transform is applied on luminance signal. The color information is embedded into luminance signal by replacing high pass sub bands by chrominance components Cb and Cr. In the recovery process at the receiving end, reverse process is applied to recover the luminance and chrominance components from the embedded image. The recovered Y, Cb, Cr, components are converted into RGB color image using inverse linear color transformation. The simulation algorithm is developed in MATLAB 7.0 environment with image processing and wavelet tool box kit.

I. INTRODUCTION

Color records exist in different ways and are commonplace in contemporary bureaus. Documents are also written, saved and electronically displayed, but are often typically printed and circulated as hardcopies. Printed paper is an essential part of an office from brochures to technical documents. We work with digitally prepared color papers that must be printed with or shipped using the traditional black-and-white fax machine using a black and white printer. So, while attempting to maintain the details expressed by the maps and pictures, we fix the issue of portraying color images in black and white. Graphics, like diagrams of pie, have possibly been made with very contrasting colors. Once the graphic color is transformed into monochrome, contrast colors are sometimes mapped to the same grey level and their visual disparity disappears. Let the original colors restored [1-2]. The first challenge is then how to transform colors in black and white so that, although they have the same luminance, different colors appear different on paper too. Besides the problem described above, we invented color-to-gray, reversible mapping; that is we can recover the original colors, provided our monochrome picture or our process, black and white printed paper.

Besides the problem described above, we invented color-to-gray, reversible mapping; that is we can recover the original colors, provided our monochrome picture or our process, black and white printed paper. The goal is to print color pictures using standard black and white (high volume) devices and to be able to restore the color picture later if necessary [3]. We are using techniques to label electronic images for this purpose. However, in order to allow a color details to be incorporated into the grey background, the paper was intended to "watermark" the printed image [4]. It is possible that someone might use ideas for electronic picture transmission, and in essence the approach suggested would be used to conveniently incorporate color into the transmission of black and white faxes [5]. This article, though, is more about imagery than telecommunications.

Textured images can appear incorrectly in this paper and represent resample of objects. This could be achieved in both PDF and print formats.

The document is set accordingly. The method for transforming Color to Gray images by adding textures is defined in Section II. Section III introduces the color information extraction system for the grey image textured. Section IV discusses some experimental studies and Section V finally contains the observations from this study.

II. FROM COLOR TO TEXTURED GRAY

The most trivial way to transform a color image into a grayscale is to maintain and use the color image luminance component. The problem with this method consists of applying the same output luminance ratios to regions of colors, shades and equivalent luminance. Alternatively, the graphic colors (typically a minimal number of colors) are determined, and all adjacent colors are assigned different grays.[6] This technique is not appropriate for complex graphics.

The color mapping for textures is another approach. Half-tone dots or shapes may be dominated by colors (e.g. hue- and saturation-dependence). Thus, regions with identical luminances in different colors can take care of different mapping since they have multiple textures. Our strategy maps texture colors. Instead, it provides a continuum of textures that naturally move between the patterns without producing visual glitches rather than a dictionary (or palette) of textures and coolers [7]. The technique functions like:

1) Color images are believed to have been in any RGB color space, and converted into Y, Cb, Cr planes using typical Linear Transformation of RGB-YCbCr, such as CCIR 601, JPEG, JPEG 2000, and so on. 3-5. Figure 1. A color space such as CIELab6 will be almost as working.

2) The luminant Y is divided into 4 sub-bands, with one degree of the wavelet transform [8]: y alternatively, Y→ (Sl, Sh, Sv, Sd) corresponding to the low-pass, longitudinal, horizontal and diagonal sub-bands (high-passes in both directions).

The dimensions of Sl, Sh, Sv, Sd are half the dimensions of Y in each direction using decimated filter banks. Sur-sampled filter banks and wavelets will generate bands of the same size as Y and function in our sense.

3) The Cb and Cr planes in each direction are spatially reduced by a factor of 2. Often it has been seen that the spatial detail in the chrominance band of a picture does not greatly impact the consistency of an image , for example. JPEG encoding. encoding.
4) Cb is substituted for sh, Cr is substituted for sv.
5) The transformation of a monochrome image is carried by a reverse wavelet (subband) [7] as (Sl, Cb, Cr , Sd) →Y'.
6) Image Y' may be written, often requiring the scale and halftoning, with the resulting grey image.

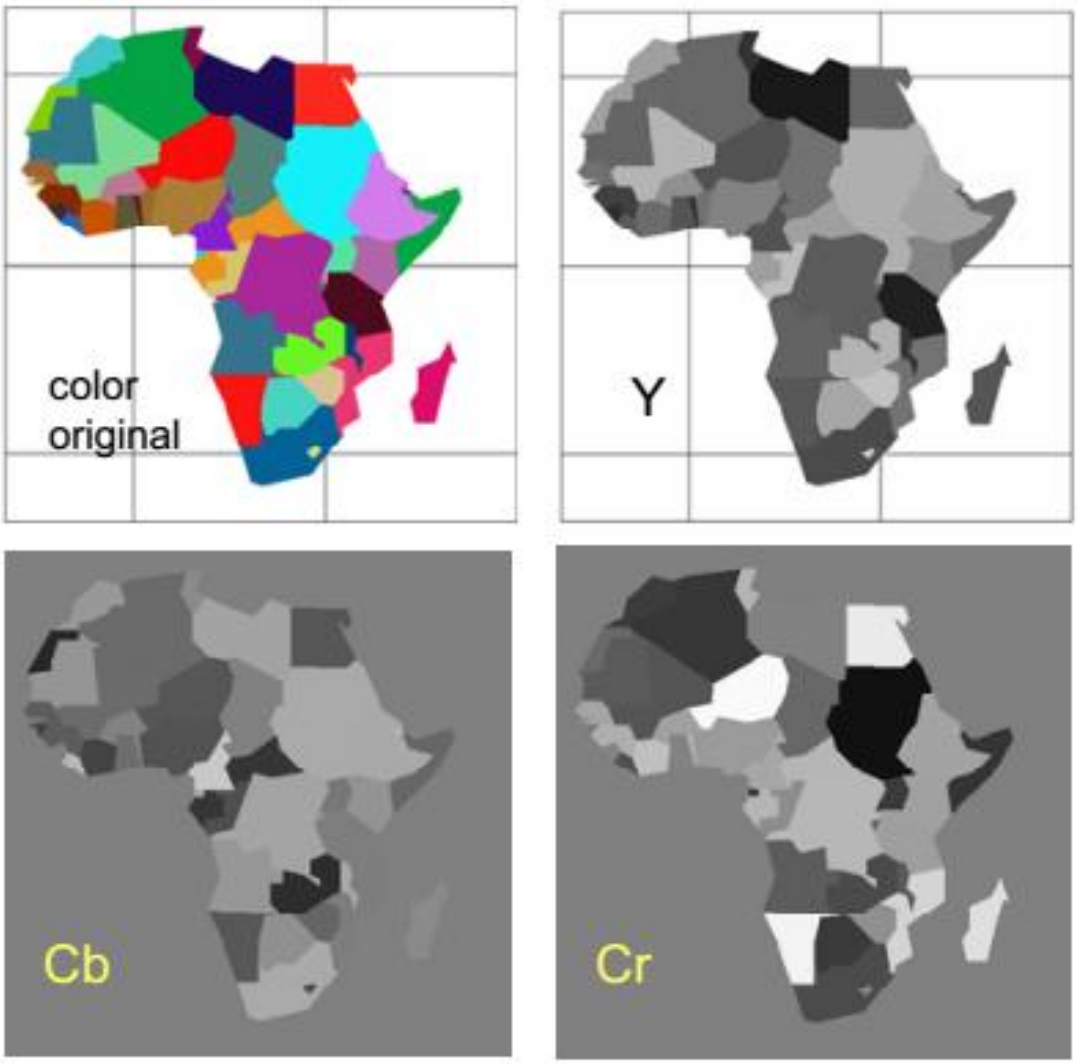

Figure 1. A color image and its Y, Cb , Cr components

Figure 2 indicates the procedure. The concept is for multiple regions to have different textures to be viewed differently, even though they have the same luminance. At a minimum, adequate separating should be given to differentiate adjacent areas. In reality by "tumbling" the wavelet, we build false high frequency patterns to assume that chromore signals are subband samples of high frequencies [9]. The high-pass bands and chromency signals are well suited to the contours of the scenic artifacts, rendering changes in texture patterns normal. The novelty of this approach is based on three other main factors aside from being based on wavelets:

(i) a grey picture and not specifically a half-one picture distinction of texture;

(ii) it is ideal for graphics and pictures with a smooth and realistic mixing of coolers;

(iii) it is reversible, which allows the recovery from the textured picture of the colors.

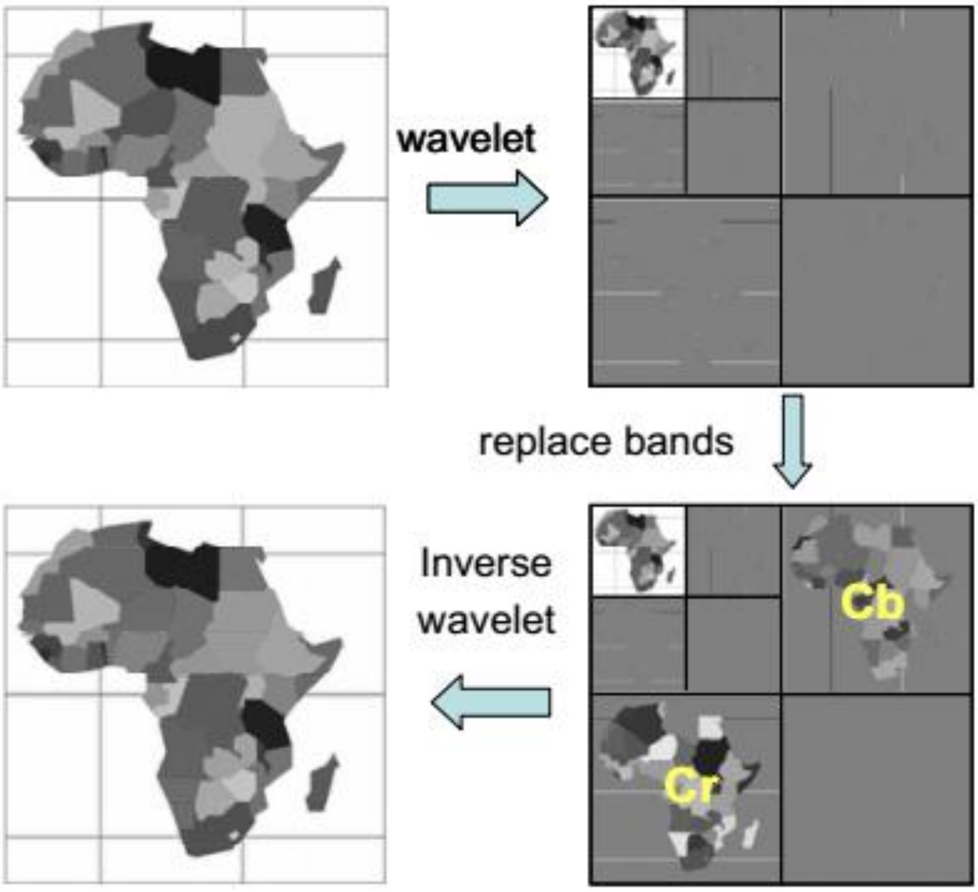

Figure 2. Color projection of monochrome images

The reader can look at some large bands in the image reconstructed due to moire, which implies the interference between the texture and the viewer resolutions. The built-in texture is even higher.

III. RECOVERING COLOR

The ability to recover coolers from the grey textured picture is a pleasant function of the proposed embedding process. To do this, we reverse the measures in the figure 3 color to grey mapping, that is to say:

1) Read or scan the grey textured image.
2) The grey picture becomes a subband by a transform wavelet.
3) The Cb- and Cr elements, which can be interpolated back to original picture scale, are the high-pass horizontal- and vertical sub-bands.
4) The sub-bands of high-pass are zeroed. (In the course of encoding, which leads to some data being loosed, the information originally found in these bands was lost)

   The Y- (grey) part of the image without texture is generated by an inverse transform.

6) Y, Cb and Cr components are obtained and utilized in the method of color embedding for reconstructing an RGB image by reverse color transform.

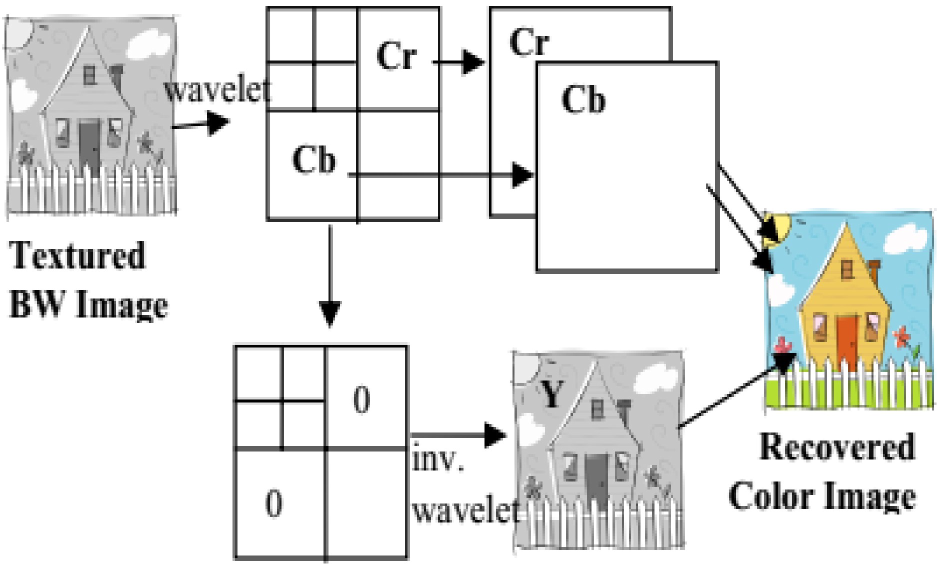

Figure 3. Retrieve grey picture colour.

A picture with a texture is read or scanned. The chrominance bands are separated from the high-pass subbands after a wavelet transition has taken place. There are null sub-bands. The Y portion is inverted and is then combined with the chromed images to recreate the colour picture.

IV. IMPROVEMENTS TO THE PROCESS

The technically sound approach for embedding and retrieving color from and into a grey picture is, however, some realistic barriers [10]. These challenges emerge as the grey picture is halved, printed and scanned:

- De-screening . The decoder (which maps a grey image back to color) needs to filter out the halftones (de-screen the image, or reverse sealing), and scale the picture to the correct size after halftoning and maybe printing and scudding the picture backwards.
  • Warping.-Warping. The picture can be bent, the paper can also be stretched. Scanning may not be perfectly matched, meaning that the grey image retrieved is a tangled version of the one before printing. Catastrophic effects can be.
- Registration. The picture has to be scanned perfectly. Any alteration in the picture texture will lead to significant changes in color.
- Blurring. As the printing process results in de-saturation of the output image, the sharp texture which we apply is blurred. This can be improved by improving the output image saturation.
- We must fix these issues:
- Scale the image to ensure printing scanning and screening (inverse half tone) before half tones and printing, so that grey texture patterns live on. We normally scale the image by a factor of 4 prior to halftoning in our simulations. A 512 x 512 pixel image is printed in a 1200 dpi printer in less than a 2x2 in2 region.
- Pre-warp and rescale before viewing the image scanned. In order to do so, we locate the corners of the image scanned and convert the scanned rectangle to a certain picture dimensions. This may involve scaling down the image to balance the space scaling before semi-toning. The downside is the picture scale of the decoder. This can be overcome by comparing the distances between image angles and the scanned frame, allowing only a limited amount of frame measurements, and determining which picture size has been used. Naturally, we must take the scaling into consideration.
- Most notably, we have modified the way we integrate color data into the subbands. This is next to be addressed. We divided chromancy details into 4 planes to make the color integration more stable with decodes of opposite colors induced by a slight image change. It is split in Cb+ and Cb- into two planes. In Cb+ we play Cb pixels larger than 0, that is. Power = (Cb > 0). The other pixels shall be set to zero. For Cb- it's the same thing. In Cb- we play Cb pixels that are less than 0, i.e. (Cb<0): Cb-. The other pixels shall be set to zero. The same is the case for Cr. Notice that Cb = (Cb+) + (Cb-) and Cr = (Cr+) + (Cr-) are respectively.

The justification for making chrominance strategies that are positive and negative is to discourage the reversing of colors. Figure 4 indicates issues. If a sub-band can only have positive and negative values, so it is a symbol of reverse texture. Hence, one can take the absolute value of the sub-bands and recombine them into Cb and Cr as in equation 1.

$$Cb = |Cb+| - |Cb-| \text{ and } Cr = |Cr+| - |Cr-| \quad (1)$$

As a result, we have 4 images to embed: Cb+, Cb-, Cr+, and Cr-. If we do a 2-level wavelet transform, the image plane Y is transformed into Y→ (Sl, Sh1, Sv1, Sd1, Sh2, Sv2, Sd2), where the level-2 sub-bands are the higher-frequency bands. Then, band replacement occurs as in equation 2.

$$Sd1 \leftarrow Cb- \; ; \; Sh2 \leftarrow Cr+ \; ; \; Sv2 \leftarrow Cb+ \; ; \; Sd2 \leftarrow Cr- \qquad (2)$$

Notice that if we are using desperately decimated filter banks and wavelets, Sd1 can have less resolution than the other three. Thus one of these chrominance channels must be reduced, say cb-, in addition to the original Y plane , i.e. to one-half of the resolution in each dimension. Figure 5 displays the color embedding scheme, while the mechanism of recovery is seen in figure 6. The color integration and retrieval measures are therefore:

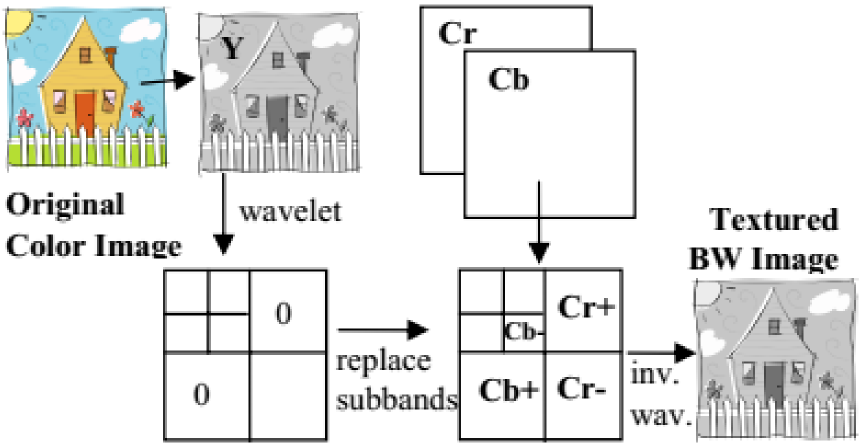

Figure 4. Converting Color To Textured Gray. The forward transformation RGB images are converted to YcbCr in chrominance planes.

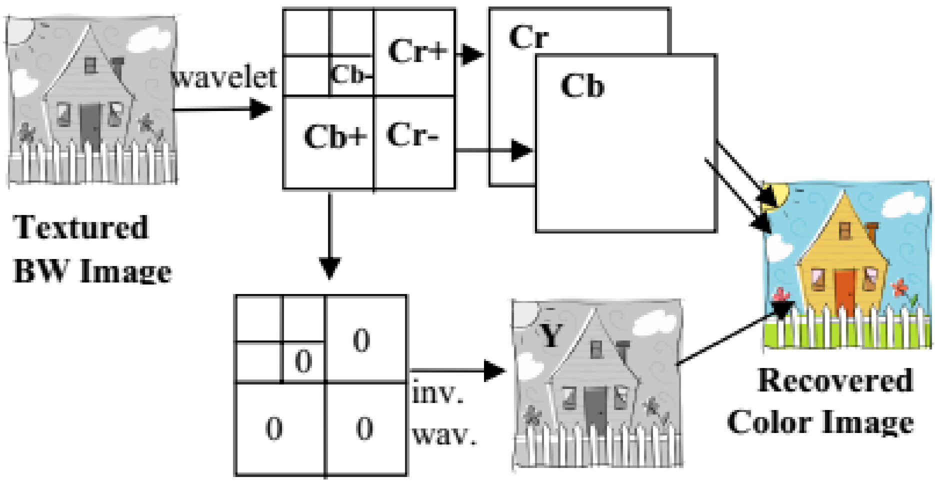

Figure 5. Color recovery from a grey background textured. Until reverse transformation, the embedded subbands are recuperated to form the chrominance planes. The YCbCr data is then returned to RGB

a) Color embedding

1) Transform RGB picture to Y, Cb, Cr (or CIELab).
2) Use a two-level wavelet transform on Y , so that Y is divided into 7 sub-bands: Y→ (Sl, Sh1, Sv1, Sd1, Sh2, Sv2, Sd2).
3) Reduce Cb and Cr by ½, construct Cb+, Cb-, Cr+, Cr-, and reduce Cb- further to ¼ of its original size.
5) Upon receiving the grey picture textured, (Sl, Sh1, Sv1, Cb-, Cr, Cb+ and Cr-) →Y, use the reverse wavelet transformations.
6) Image Y' may be written, often requiring the scale and halftoning, with the resulting grey image.

b) Color recovery

1) Read or scan the gray textured image.
2) Determine image dimensions.
3) If necessary, identify corners and carry an affine transform to de-warp the gray image.
4) Reduce image to the correct resolution.
5) Use a wavelet transform to convert the gray image into subbands Y'→ (Sl, Sh1, Sv1, Sd1, Sh2, Sv2, Sd2).
6) Interpolate Sd1, doubling its resolution.
7) Make Cb = |Sv2| - |Sd1|, and Cr = |Sh2| - |Sd2|.
8) Interpolate Cb and Cr, doubling their resolutions.
9) Remove the embedded sub-bands, i.e. set Sd1 = Sh2 = Sv2 = Sd2 = 0, and take the inverse wavelet transform to find Y as (Sl, Sh1, Sv1, 0, 0, 0, 0) → Y.
10) Convert the Y,Cb,Cr planes back to RGB.

V. RESULTS

We evaluated the printing and scanning period with and without the algorithm. A non-uniform stretching and rotation which may occur after printing and then scanning in the image is the great difficulty in printing and scanning. This is a complicated registration issue common to many reading machines and beyond this article. Registration is not a problem in some situations, such as submitting half-tone pictures through regular black and white faxes. A standard color picture is shown in 8. Figure displays the textured images. 9. The textures of high frequency are low visibility and mix well with the image. The textured image is also specialized in each direction, before printing, using an integer factor K (e.g. K=4), so that the texture survives the printing and scanning process. In simulation, the scaled image is halved with the default diffusion of error or with some other form, and reduced to recompose a grey image with the average KxK binary pixels. The higher the K, the better the rebuilding. In order to detect the consistency of color image restoration, for several K values in a single image (different than that seen in Figure 8) we computed the peak signal-to-noise ratio (PSNR) between input and recovered RGB pictures. Figure 10 displays "the wine" picture reconstructed with a factor of scaling K=4. The results are shown in table I.

Table 1. Peak SNR (dB) evolution for a given scaling factor K for image kids

K	PSNR (dB)
1	13.4
2	23.1
3	24.9
4	27.6
5	28.3
8	29.1
10	29.7

The same image had been printed on a regular K=4 laser printer of 600 dpi and scanned on a scanner of 1200 dpi. The figure shows part of this scanned chart. Eleven. The resulting image after color recovery will be seen in Figure after the application of the affine transformations to un-warring and to de-rotate the grey textured image. Note the brightness of the colors. But much of the picture pieces have been properly restored. This is a real printing and scanning test that creates uniform distortions of the image. We consider pictures like those seen in figure 12 to be excellent results considering both nonlinear and unpredictable variables extracted from the physical processes involved. In addition, the retrieved image can be analyzed. As we have lost color saturation and information (throughout the phase we have taken out some high frequency sub-bands), figure 13 shows the picture12 after enhancing hue and sharpening overall. This leads to Figure. 13, as we began with the picture in the Figure, is still a rather good reproduction. .

Figure 8. Example original color image.

Figure. 9. Textured image.

Figure 10. Enlarged portion to show texture.

Figure 11. Image recovered after halftoning and scaling with k=4

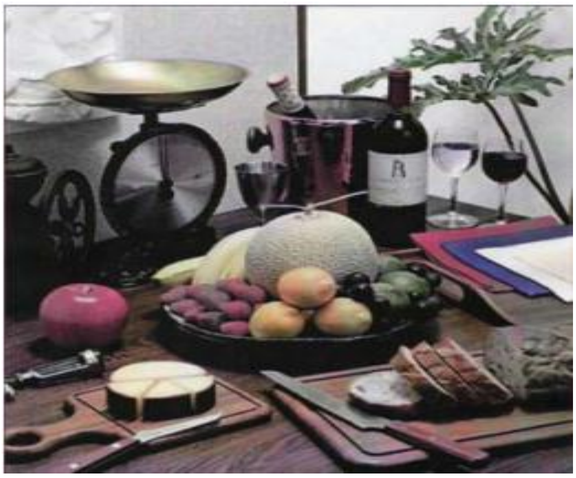

Figure 12. Color image reconstructed

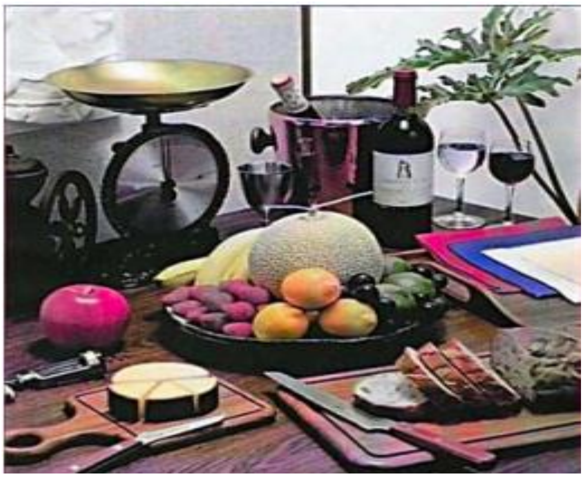

Figure 13. Enhanced reconstructed image.from textured printed image.

VI. CONCLUSIONS

We proposed a way to transform color images to invertible grey, allowing colors with equivalent light values to be easily separated. The highlight of the paper is that color to grey mapping cannot be transformed by color mapping into textures that can subsequently be decoded and transformed into color. Any other effort is unknown to us. The system is based on wavelets and chrominance planes to replace subbands. The process enables one to send color images to a binarized grey images via standard black and white fax systems. It is also helpful when you don't have a color printer, but you must still print the paper. One may want the colors from the typed black and white hardcopy to be retrieved later. There are also problems with registration and geometric distortions.

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