Chapter 12

An Efficient Color Image Encoding Scheme Based on Colorization

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ABSTRACT

Image colorization is a new image processing topic to recolor gray images to look as like the original color images as possible. Different methods have appeared in the literature to solve this problem, the way that leads to thinking about decolorization, eliminating the colors of color images to just small color keys, aid in the colorization process. Due to this idea, decolorization is considered as a color image encoding mechanism. In this chapter, the authors propose a new decolorization system depends on extracting the color seeds (Representative Pixels [RP]) using morphology operations. Different decolorization methods are studied and compared to the system results using different quality metrics.

INTRODUCTION

Image colorization is the process of adding colors to black and white images. One of the problems of colorization is how to select the suitable colors, mainly the original colors, to generate a colored image similar to the original color one. Different colorization methods treats this problem in the literature, most of these trials are covered and discussed in our previous publications (Semary, 2011), (Semary, 2012). One of the common colorization methods is A. Levin et al. technique (Levin, Lischinski, & Weiss, 2004) where the user draws some scribbles on a gray image using a color palette and a brush like tool, then the computer colorizes the image using optimization depending on the fact, the nearby pixels in gray should have the same color.

Levin’s method depends on user selection of positions and colors of the scribbles. So it’s an important aspect in his method to practice well; where to draw the scribbles and what is the suitable color to be selected for obtaining a color image as the original one. Because of these drawbacks, many researchers like Yao Li et al. (Li, Lizhuang, & Di, 2007) and Liron. Yatziv et al. (Yatziv & Sapiro, 2006) and more appeared in the literature;
improve Levin’s algorithm quality; speed and the needed number and positions of the scribbles.

Decolorization is a new research field appeared after the fast development in image and video Colorization area. Decolorization means to convert the color image to grayscale by eliminating the colors in the image but keeping some clues refer to the original colors to be used in the Recolorization process; to obtain a recolored image looks like the original one.

From our point of view and literature study, there are two trends for decolorization (Semary, 2011):

**Color Embedding:** Where the chromatic channels are processed to be hidden or embedded in the gray image. The inverse of the hiding process is performed to extract the color channels back and merge them with the gray (lightness) channel to obtain the color image again, but in lower quality than the original one. This field leads to thinking about encoding color images using decolorization. Ricardo et al. (de Queiroz & Braun, 2006), (de Queiroz, 2010) used wavelet sub-bands to hide chromatic channels. The resulted gray image was a textured one differs a lot from the original gray image but they proposed their method for faxing applications that enables sending the color image by the traditional fax and recolorize them back after receiving. Takahiko Horiuchi et al. (Horiuchi, Nohara, & Tominaga, 2010) used a second-level Haar wavelet transform with a packet assignment technique. The proposed algorithm distributed color information effectively in one-level wavelet subbands for preserving the chroma and spatial resolution. The application permitted color recovery only to a specific user with a key.

Chaumont and Puech (2009) proposed a method to embed the color information of an image in a corresponding grey-level image. This method was made of three major steps which were a fast color quantization, an optimized ordering and an adapted data hiding. The principle was to build an index image which is, in the same time, a semantically intelligible grey-level image. In order to obtain this particular index image, which should be robust to data hiding, a layer running algorithm was proceeded to sort the K colors of the palette.

The algorithm searches for the best scribbles or seeds can be extracted and sent with the gray image to be used in the colorization process. This trend is suitable for user selection colorization techniques, where the decolorization process usually made automatically without user scribbles selection (Vieira, et al., 2003). Next section explains most well-known works in this trend.

**RELATED WORKS**

One on the simplest methods for color seeds extraction is Brooks’ et al. method (Brooks et al., 2007), where the representative pixels (seeds) were selected using sampling (Figure 1).

T. Miyata et al. (Miyata, Komiyama, Sakai, & Inazumi, 2009) proposed a decolorization methodology depends on extracting line segments from the color image to be the scribbles for the colorization process. Their process based on Levin’s colorization method, where the colorization process is a basic block in their system framework what leads to a lot of computational time. The authors compared their algorithm results with Cheng’s method (Cheng & Vishwanathan, 2007) where the last one algorithm uses active learning feedback to propagate the selection of the seeds and extracts RP pixels as seeds instead of lines and scribbles (Figure 2, Figure 3).

Rusu et al. (Rusu & Tsaftaris, 2013) has proposed another iterative method that provides insights as to the relationship between locally vs. globally important scribbles. First, the RPs have been selected in random from the image, then the system has to define a scribble contribution measure based on the reconstruction error. Although the main objective of their work is to select the best seeds for colorization process, they assumed the availability of the color image. They didn’t